Engineering Library

JAN 30 1926

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLI.—No. 3654] LONDON: FRIDAY EVENING, JANUARY 8, 1926 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Some Machines at the Rugby Wireless Station.

Aeronautics in 1925—No. II.

The Physical and Optical Societies' Exhibition.

Electrical Engineering in 1925—No. II.

Metallurgical Education.

Harbours and Waterways in 1925.

Steam Turbine Plant for an Old Cotton Mill.

Water Supply in 1925.

A Locomotive Feed Water Heater.

PUBLIC NOTICES

Army Contracts.

NOTICE is HEREBY GIVEN that TENDERS for Quantities of the undermentioned MANUFACTURED GOODS are INVITED from time to time as required :—

METAL TRADES, &c.:
Aluminium Castings and Pressings, Bedsteads, Cutlery, Copperware, Enamelled Ware, Fencing (Woven Wire and Strained Iron Wire), Field Forges, Hollowware, Lamps and Lanterns, Nails, Saddletrees, Sash Chains, Scratch Card, Screws, Shovels, Stoves, Grates, &c., Telegraph Poles (Iron), Tin-plates, Tinware, Tools, Tubing, Wire.

TEXTILE TRADES, &c.:
Blankets, Braids, Buckram, Canvas and Canvas Goods, Cloth, Cordage, Cottons and Cotton Goods, Cotton Waste, Cotton Waste for Guncotton, Embroidery, Flags, Flannel, Headdresses, Horse Rugs, Hosiery (including Hose Tops), Linens and Linen Goods, Moquette, Puttees, Sewing Cotton and Thread, Silk, Sponge Cloths, Stockinette, Tapes, Tents, Webs, Worsted Gloves.

ELECTRICAL AND SCIENTIFIC INSTRUMENT TRADES :
Cables, Electrical Stores, Scientific Instruments.

GENERAL TRADES :
Boots and Shoes, Boxes and Chests, Brushes and Brooms, Candles, Chemicals (including Acetone, Alcohol, Aluminium Powder, Anhydrous Ammonia, Barium Nitrate, Magnesium Powder, Soda), Chinaware, Combs, Cooperage, Earthenware, Furniture, Glassware and Splinterless Glass, India-rubber Goods, Leather Goods, Paint (including Paint, Zinc Oxide, Dry), Soap, Stable Fittings, Timber, Vehicles, Woodware.

Manufacturers who are not already on any War Office List of tenderers and who may wish to be invited to tender for Army requirements of the above stores, should apply to the Director of Army Contracts at the address given below for Form 1, on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods for which they wish to be noted and will be required to furnish the names of at least two well-known firms or public bodies who have purchased from them and are in a position to certify as to the quality of their productions. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the decision of His Majesty's Government that "save in very exceptional circumstances, all firms contracting for Government contracts to whom the conditions of membership of the King's Roll are applicable must be on the King's Roll."

SALES.—From time to time the Department has for sale surplus army stores of various descriptions, among which may be mentioned Machinery, Electrical Stores, Hutting, Mechanical Transport, Drugs, Medical and Dental Stores, Veterinary Stores, Laboratory Apparatus. Firms who wish to be invited to tender for the purchase of surplus stores should apply as directed below.

All applications should be in writing, and should be addressed to the Director of Army Contracts, Caxton House (West), Tothill-street, Westminster, London, S.W. 1. No application is necessary from firms whose names are already on the War Office lists.

N. F. B. OSBORN,
Director of Army Contracts.
1286

The Director-General,

India Store Department Branch No. 15, Belvedere-road, Lambeth, S.E.1, invites TENDERS for—

1. WIRE ROPES for Aerial Ropeway.
2. BOGIE TIMBER TRUCKS and BODY FITTINGS, for Goods Brake Vans.

Tenders due on the 19th January, 1926, for No. 1, and on the 26th January, 1926, for No. 2.
Tender forms obtainable from above. 1281

Civil Engineer Required

by the GOVERNMENT of NYASALAND for the PUBLIC WORKS DEPARTMENT. The selected candidate will be eligible for admission to the permanent and pensionable establishment after the completion of two tours of 20 to 30 months' continuous residential service or five years' satisfactory service on agreement. Salary £400, rising to £500 a year by annual increments of £20, and thence to £600 a year by annual increments of £25. Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25-30, must be A.M.I.C.E. or hold equivalent professional qualifications and have had good experience on road survey and construction. Experience in the design and erection of steel and timber bridges and buildings is also necessary. Must be able to ride a motor bicycle.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/14,046. 1257

Draughtsman, Grade II.,

REQUIRED for Instrument Design. Good technical knowledge and some experience in the design of instruments or small precision apparatus are essential. Starting salary £125 per annum plus Civil Service bonus, giving a present starting remuneration of £205 3s. per annum, on the scale £125-£7 10s.-£150 plus bonus. Ex-Service man preferred.—Apply, stating full particulars and quoting reference No. A.90, to the SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 1237

The High Commissioner

for India REQUIRES an ASSISTANT ENGINEER INSPECTOR (MECHANICAL)

for service in England. The post is on a non-pensionable basis, and will be held in the first instance on probation for two years, during which period the services of the incumbent may be dispensed with at one month's notice. Thereafter service will be terminable by six months' notice on either side.

Salary £150, rising by annual increments to £300. Prospect of £310, rising by annual increments to £400, by promotion to Inspector. These salaries carry a variable cost-of-living bonus on the Civil Service scale. At present the bonus on £150 amounts to £88.

Candidates should be 28 to 35 years of age, have good technical and shop training and have held some position of responsibility. All-round rather than specialised experience is desirable. Preference given to A.M.I. Mech. E. or equivalent. Previous inspection experience not essential.

Applications, stating age, training and experience, and enclosing copies of recent testimonials, to be sent to the DIRECTOR-GENERAL, India Store Department, Belvedere-road, Lambeth, S.E. 1, not later than 15th January, 1926. 1199

PUBLIC NOTICES

Computer Required for

the CADASTRAL FRAMEWORK PARTY, GOLD COAST SURVEY DEPARTMENT, for two tours of not less than 8 nor more than 18 months' residential service. Free passages, travelling and field allowance whilst on duty 5s. a day. Outfit allowance of £60 on first appointment. Salary £600 a year. Candidates, aged 25-35, must be capable of and have had experience in the Computing of Triangulation and Rigid Theodolite Traverses.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M.13,965. 1280

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that

OTTO AUGUST BANNER, of 2703, Highland Boulevard, Milwaukee, State of Wisconsin, United States of America, a German citizen, SEEKS LEAVE to AMEND the SPECIFACATION of LETTERS PATENT No. 220,344, granted to Stanley Gordon Sinclair Dicker, for an invention entitled "Improvements in the Combustion Chambers and Fuel Injection Arrangements of Internal Combustion Engines."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 23rd December, 1925.

Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
Comptroller-General.
1240

Cape Technical College.

DEPARTMENT OF PRELIMINARY TECHNICAL STUDIES.

APPLICATIONS are INVITED for the POST of LECTURER in PRELIMINARY TECHNICAL STUDIES. Salary £400-25-£550. Applicant should be qualified to Teach Engineering Science, Mathematics, Machine Drawing and other cognate subjects. The possession of a University Degree and/or Teaching and Practical Experience will be considered in making the appointment.

Initial salary will be fixed according to experience.

Applications should be submitted in duplicate on the prescribed forms, to be obtained from the undersigned, which will be received up to 31st January, 1926. They should be accompanied by certified copies of testimonials of practical and teaching experience, and should state age of applicant.

The appointment will be subject to the conditions of service, a copy of which may be obtained on application.

Successful applicant will be allowed the sum of £50 towards travelling expenses to South Africa.

Apply in the first instance to
Messrs. CHALMERS, GUTHRIE and CO., Ltd., 37, Threadneedle-street,
London, E.C. 2. 1284

Northampton Polytechnic

INSTITUTE,
ST. JOHN-STREET, E.C. 1.
ARMOURERS' AND BRAZIERS' COMPANY LECTURES IN METALLURGY.
By Dr. W. ROSENHAIN, F.R.S.

The remaining Two Lectures of the series will be given at the above Polytechnic on Wednesday, January 13th and 20th, 1926.

The Lectures will deal respectively with the Metallography of Copper and its Alloys and of Aluminium and its Alloys.

Admission free, without ticket.

S. C. LAWS, M.A., M.Sc.,
Principal.
1276

PUBLIC NOTICES

University of the Witwatersrand, JOHANNESBURG.

DE BEERS' PROFESSOR OF MECHANICAL ENGINEERING.

APPLICATIONS are INVITED for the DE BEERS' CHAIR OF MECHANICAL ENGINEERING at the above University.

The holder of the Chair is assisted by several Lecturers, and the workshops will be under his charge. New Laboratories for the Department are now in process of being built and equipped.

The salary will be at the rate of £1000 per annum, rising to £1100 by two annual increments of £50. An amount of £100 will be allowed for passage expenses to South Africa. In addition, a free first-class ticket is provided from Cape Town to Johannesburg, and half salary is paid during the voyage.

Participation in the University Teachers' Provident Scheme is compulsory.

The appointment, which is a full-time one, is subject to all the conditions and rules now in force, and duty is to be assumed as early as possible.

Further particulars as to conditions of service may be obtained from the SECRETARY, Office of the High Commissioner of South Africa, Trafalgar-square, London, W.C. 2, from whom forms of applications may also be obtained.

Applications (7 copies of each) accompanied by testimonials, should reach the High Commissioner of South Africa not later than the 1st February, 1926. 1182

City of Nottingham.

TO CONTRACTORS AND BUILDERS.
NEW TRAM DEPOT, &c.

The Tramways Committee is prepared to receive TENDERS for the above BUILDINGS, comprising Sheds, Offices, and Sale Shops, covering an area of 2½ acres.

Drawings may be seen and specification and quantities obtained on and after Wednesday, 13th January, 1926, from Mr. T. Wallis Gordon, City Engineer, Guildhall, Nottingham, on payment of Three Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, in the official envelope provided, are to be delivered to the undersigned not later than Twelve o'clock Noon, Thursday, 28th January, 1926.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be considered from firms having the necessary plant and experience and who conform with the conditions of the contract as regards paying the local standard rate of wages, &c., and with the working rules of the Nottingham district.

By Order,
W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
4th January, 1926. 1265

Royal State Railway Department of Siam.

Sealed TENDERS for the SUPPLY of ALL-STEEL GOODS WAGONS, B.E. 2460, will be received by the undersigned at his office up to Fourteen o'clock on Monday, the 29th March, 1926, at which place and hour the Tenders will be publicly opened and read.

Blank Tender forms, specifications, and plans may be obtained from Messrs. C. P. Sandberg, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £1 10s. per set, which sum will not be refunded.

Right is reserved to reject any or all Tenders and to accept any Tender which, in the opinion of the undersigned, is to the best interests of the Royal State Railways.

Royal State Railway Department of Siam,
PURACHATRA,
Commissioner-General.
1252

PUBLIC NOTICES

Port of Bristol Authority.

NEW ELECTRIC CRANES—BRISTOL.

The Docks Committee are prepared to receive TENDERS for the CONSTRUCTION of THREE 2-TON MOVABLE ELECTRIC JIB WHARF CRANES and the ERECTION of the same on the Quay Wall at Sheds "E" and "F," The Grove, Bristol. The cranes are to be equipped with 3-phase, high-torque, squirrel-cage motors throughout.

On and after Monday, the 11th day of January, 1926, copies of the specification and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £3 has been paid to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol. ALL CHEQUES MUST BE MADE PAYABLE TO THE BRISTOL DOCKS COMMITTEE. The deposit of £3 will be returned to all bona fide tenderers after the receipt of a Tender with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Three 2-Ton Electric Cranes," addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 1st day of February, 1926.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE
Chief Engineer.

Chief Engineer's Office,
Avonmouth Docks,
8th January, 1926. 1271

TENDERS.

Shardlow Rural District Council.

CONTRACT NO. 1.
WATER SUPPLY FOR THE PARISHES OF OCKBROOK, DRAYCOTT, BREASTON, ELVASTON, CHELLASTON, SHARDLOW AND ASTON-ON-TRENT, DERBYSHIRE.

The above-named Council invite TENDERS from responsible contractors for the CONSTRUCTION of WATERWORKS at the above. The contract comprises the Laying of 2755 Yards of 9in. Cast Iron Pipes, 1913 Yards of 8in., 3648 Yards of 7in., 1434 Yards of 6in., 575 Yards of 5in., 11,424 Yards of 4in., and 18,892 Yards of 3in. Cast Iron Pipes, with all Appurtenances, and the CONSTRUCTION of a CONCRETE RESERVOIR (capacity 500,000 gallons).

Plans may be seen and specification and bills of quantities obtained at the offices of the Engineers, Messrs. Elliott and Brown, Chartered Civil Engineers, Burton Buildings, Parliament-street, Nottingham, after January 13th, on deposit of cheque for Five Guineas, which sum will be returned on receipt of a bona fide Tender, not afterwards withdrawn, and return of all documents.

Sealed Tenders, addressed to me and endorsed "Tender for Waterworks, Contract No. 1," to be delivered at my office on or before the first post on Friday, February 5th, 1926.

The lowest or any Tender will not necessarily be accepted.

By Order,
J. SPENCER,
Clerk to the Council.
3, St. Mary's Gate, Derby. 1266

Shardlow Rural District Council.

CONTRACT NO. 2.—CAST IRON PIPES.
WATER SUPPLY FOR THE PARISHES OF OCKBROOK, DRAYCOTT, BREASTON, ELVASTON, CHELLASTON, SHARDLOW AND ASTON-ON-TRENT, DERBYSHIRE.

The above-named Council invite TENDERS from responsible Ironfounders for the SUPPLY and FREE DELIVERY of CAST IRON PIPES, SPECIAL CASTINGS, &c., in connection with the above Water Scheme.

The contract will comprise about 1330 Tons of Iron Castings as follows :—226 Tons of 9in., 133 Tons of 8in., 207 Tons of 7in., 65 Tons of 6in., 20 Tons of 5in., 288 Tons of 4in., and 362 Tons of 3in. diameter Pipes; also 29 Tons of Special Castings.

Full particulars with specification, bill of quantities, and form of Tender may be obtained from the Engineers, Messrs. Elliott and Brown, Chartered Civil Engineers, Burton Buildings, Parliament-street, Nottingham, on deposit of Five Guineas, which sum will be returned on receipt of a bona fide Tender, not afterwards withdrawn.

Sealed Tenders, addressed to me, and endorsed Tenders for Iron Pipes, Contract No. 2," to be delivered at my office on or before the first post on Friday, February 5th, 1926.

The lowest or any Tender will not necessarily be accepted.

By Order,
J. SPENCER,
Clerk to the Council.
3, St. Mary's Gate, Derby. 1267

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.

SITUATIONS WANTED, Page 2.

PATENTS, Page 2.

PARTNERSHIPS, Page 2.

AGENCIES, Page 2.

AUCTIONS, Page 96.

FOR SALE, Pages 3, 4 and 96.

BUSINESSES and PREMISES (For Sale, etc.), Page 3.

MACHINERY, &c., WANTED, Page 3.

WORK WANTED, Page 4.

For Advertisement Rates see Page 45, Col. 1.

INDEX TO ADVERTISEMENTS Page 95.

PUBLIC NOTICES

Swanage Urban District Council.

ERECTION OF GROYNES.

The above Council are prepared to receive TENDERS for the CONSTRUCTION of TWO GROYNES on the beach at Swanage, in accordance with plans and specification prepared by Mr. Ernest Latham, F.C.G.I., M.I.C.E., M.I.M.E., Consulting Engineer. Contractors accustomed to marine work of this character desirous of submitting Tenders are requested to furnish their names to the undersigned on or before the 18th January, 1926.

THOS. ARNOLD,
Clerk to the Council.

Town Hall, Swanage,
4th January, 1926. 1248

The South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

STRUCTURAL STEEL WORK.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Structural Steel Work," must be left with the undersigned not later than Twelve Noon on Friday, the 22nd January, 1926.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

W. B. REYNOLDS,
For Managing Director.

91, Petty France, S.W. 1.
31st December, 1925. 1254

The South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. STEEL FISH-PLATES.
2. W.I. TIE BARS.
3. FISH BOLTS, NUTS and WASHERS.
4. FOUNDRY COKE.
5. PLATE and SHEET GLASS.
6. C.I. POT SLEEPERS.

Specifications and forms of Tender will be available at the Company's offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Steel Fish-plates," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 22nd January, 1926.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of specifications Nos. 1 and 2, of 5s. for each copy of specifications Nos. 3, 4 and 5, and of £1 for each copy of specification No. 6.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

W. B. REYNOLDS,
For Managing Director.

91, Petty France, S.W. 1.
6th January, 1926. 1315

Egyptian State Railways, Telegraphs and Telephones.

APPLICATIONS are REQUIRED for the POSITION of CARRIAGE WORKS MANAGER on the above Railway at a salary of £E.1000 per annum, on a contract for two years. Application must be made on the official application form, which can be obtained, together with list of qualifications and specimen contract, from the CHIEF INSPECTING ENGINEER, Egyptian Government, 41, Tothill-street, S.W. 1.

No allowances will be paid in addition to the salary mentioned. 1287

Jodhpur Railway.

ASSISTANT CIVIL ENGINEER.

REQUIRED, for service in the Engineering Dept. of the above Railway, an ASSISTANT CIVIL ENGINEER, not more than 30 years of age and unmarried preferred.

Candidates should have been educated at a recognised public school and must have passed the examination for the A.M. Inst. C.E. or possess a B.Sc. degree or the diploma of a recognised Engineering College.

In addition they must have had at least 4 years' civil engineering experience in the Way and Works Department of a British, Indian, or Colonial Railway as Assistant Engineer.

SALARY.—Rupees 675 per calendar month, rising in accordance with the rules in force.

TERMS.—A first-class free passage to India, with a three years' agreement in the first instance.

Applications will be received by letter only, and candidates must give full particulars of their general and technical education and subsequent training and experience in chronological order, with dates.

Letters should be addressed to the undersigned not later than 21st January, 1926.

RENDEL, PALMER AND TRITTON,
Appointments Dept.,
12-14, Dartmouth-street, Westminster, S.W. 1. 1253

Urban District Council of Kettering.

APPOINTMENT OF ENGINEER AND SURVEYOR.

APPLICATIONS are INVITED for the APPOINTMENT of ENGINEER and SURVEYOR and WATER ENGINEER to the above-named Council.

Candidates must be under 45 years of age and be Members or Associate Members of the Institution of Civil Engineers, or have obtained the Testamur of the Institution of Municipal and County Engineers.

Commencing salary £750, rising by three annual increments of £50 to a maximum of £900 per annum.

The appointment will be subject to the provisions of the Local Government and Other Officers' Superannuation Act, 1922.

The present holder of the office will relinquish his appointment on the 30th June next, and the successful candidate will be required to take up his duties not later than 1st June, as may be arranged.

Further particulars and forms of application may be obtained from the undersigned.

Applications, on the prescribed form, with copies of three recent testimonials, must reach me not later than Monday, the 25th day of January instant.

Canvassing in any form will disqualify.

JOHN BOND,
Clerk to the Council.

Council Offices, Kettering,
5th January, 1926. 1268

The Metropolitan Asylums Board

invite APPLICATIONS for the APPOINTMENT of a FIRST-CLASS ENGINEERING DRAUGHTSMAN in the Department of the Engineer-in-Chief, to Prepare Working Drawings, Specifications and Estimates for Plant Lay-outs in large hospitals, in particular of Laundries, Central Kitchens and Steam Boiler Plants.

The salary is £315 per annum, rising by £15 per annum to £360 per annum.

Candidates must not be less than 28 nor more than 38 years of age.

Application forms can be obtained from the Clerk to the Metropolitan Asylums Board, Victoria Embankment, E.C. 4, on and after Tuesday, 12th January, 1926, and must be returned, accompanied by copies of not more than three testimonials, not later than Thursday, January 21st, 1926. Envelopes must be endorsed "Application for Draughtsman," and request for application form must be accompanied by stamped addressed envelope.

C. A. POWELL,
1303 Clerk to the Board.

SITUATIONS OPEN

MESSRS. HEATLY and GRESHAM, Ltd., Beg to state that the VACANCY for Commercial Engineer, appearing in "The Engineer" of the 13th November, 1925, HAS BEEN FILLED. 1292 A

WANTED by Firm of Pump Engineers in the South of England, a MAN with sound technical knowledge of Pumps and Pumping Problems, to act as TRAVELLING REPRESENTATIVE. Salary and commission on orders obtained.—Address, giving age, experience, and salary required, 1235, The Engineer Office. 1235 A

WANTED for Large Textile Machinery Manufacturing Company, a first-class MAN with thorough knowledge of Modern Machine Tools and Methods and experienced in planning new operations and methods for cheap production. Only first-class experienced man considered. State age, salary expected, and full details of experience in this work. In confidence.—Address, 1242, The Engineer Office. 1242 A

WANTED, MANAGER for FOUNDRY in Scotland employing 250 hands; experience of Gas-holders, Oil Tanks and Electric Plant essential.—Address, with testimonials and stating experience and salary expected, 1204, The Engineer Office. 1204 A

A FIRM of ENGINEERS, MERCHANTS and IMPORTERS established in Calcutta have a VACANCY for an ASSISTANT from 25 to 30 years of age. Must have been trained as an Engineer, unmarried. Previous Indian experience desirable, knowledge of Oil Engines, Pumping Plant, Railway Material essential. Commencing salary 500 rupees a month, with prospects.—Reply, Box C.M. 499, c/o Dawson's Advt. Offices, 118, Cannon-street, London, E.C. 4. 1259 A

ASSISTANT WORKS MANAGER REQUIRED for Crane Works manufacturing Electric Overhead Travellers, Wharf Cranes, Steam Cranes, &c. Must be energetic and conversant with modern shop methods. Previous experience essential. State age, experience, and salary required.—Address, 1251, The Engineer Office. 1251 A

CIVIL ENGINEERING ASSISTANT REQUIRED, experienced in the Calculation and Design of Constructional Steel Work and Reinforced Concrete. Preference given to ex-Service man.

State age, qualifications, experience, and salary required to Box 884, c/o Pool's, 180, Fleet-street, E.C. 1236 A

COST CLERK WANTED for Steel Tube Works, Birmingham; must have had sound training; some experience in similar trade an advantage. State age, salary and experience.—Address, 1316, The Engineer Office. 1316 A

HEATING ENGINEER.—Established London Firm REQUIRES SERVICES of thoroughly qualified HEATING ENGINEER, to Take Charge of Heating and Cooking Section. Applicants must be of good address, be thoroughly experienced in all branches, and must be personally known to architects and consulting engineers, and able to introduce business. To an energetic and reliable man a good position is offered.—Write, giving fullest information, salary required, in confidence, to P1350, The Engineer Office. P1350 A

JUNIOR REPRESENTATIVE REQUIRED for a Firm of London Chemical Engineers. A good opening for a young man of sound engineering education, personalities and address.—Address, P1394, The Engineer Office. P1394 A

WORKS ASSISTANT WANTED, to TAKE CHARGE; used to Railway Car Construction, shop organisation and piecework rates. Works situate within 20 miles of London. State salary and experience.—Address, P1369, The Engineer Office. P1369 A

WANTED, DRAUGHTSMAN, Textile and Chemical experience, AT ONCE.— Address, 1272, The Engineer Office. 1272 A

WANTED, Fully Qualified LEADING DRAUGHTSMAN for Bleaching and Finishing Machinery. Age about 35. State age, experience, and salary expected.—Address, 1177, The Engineer Office. 1177 A

WANTED, LEADING DRAUGHTSMAN, with latest experience of Condensing Plant, Feed Heating Systems, and modern Power Station Lay-out. State age, salary, full particulars experience, with references.—Apply by letter only to THE MIRRLEES WATSON CO., Ltd., Scotland-street, Glasgow. 1269 A

A FIRST-CLASS DRAUGHTSMAN REQUIRED by a large Crane Firm in Yorkshire; preference will be given to one who has had Designing in addition to Detailing Experience in all types of Cranes. Progressive position for suitable applicant.—Address, giving full particulars of experience, age and salary required, 1297, The Engineer Office. 1297 A

DRAUGHTSMAN, Experienced Locomotive Man, WANTED AT ONCE.—Write, stating experience, salary required, and when at liberty, THE AVONSIDE ENGINE CO., Ltd., Bristol. 1279 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 448 A

INDIA.—DRAUGHTSMAN REQUIRED, with First-class theoretical knowledge of Bridge and Light Structural Work and preferably also with practical experience. Age 25 to 28 years.—Apply, with full details of training and experience, with copies of testimonials, to "Z. F. 648," c/o Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 1258 A

MACHINE TOOL CHIEF DESIGNER and ESTIMATOR WANTED. Must have a thorough experience in modern Machine Tools for the production of Railway Rolling Stock. This position offers an excellent opportunity of future progress for thoroughly capable engineer. State age, full particulars of experience, and salary required.—Address, 1250, The Engineer Office. 1250 A

RAILWAY COMPANY HAS VACANCY for MACHINE TOOL DRAUGHTSMAN. Must have had considerable experience in Special Purpose Machine Tools, Jig and Tool Design and Plant Lay-out. Applicants must give full and clear particulars of experience, age and salary required, together with copies of testimonials.—Address, 1295, The Engineer Office. 1295 A

MACHINE SHOP FOREMAN, First-class Man, to Take Entire Charge. Good opportunity for a really competent man conversant with modern methods in Detailed Repetition Work of varied nature. State full experience and salary required.—Address, 1282, The Engineer Office. 1282 A

WANTED for East Coast Africa, LEADING FITTER Take Charge of Repairs to sixteen Light Locomotives and about 1000 Trucks. Wages £35 month, passage paid both ways, 3 years' agreement. Single man preferred.—Write, stating age and experience, to Box "F. M. A.," c.o. Davies and Co., 95, Bishopsgate, London. 1283 A

FIRST-CLASS BLACKSMITH REQUIRED for service abroad with an important English Oil Company. Intending applicants should be capable of turning out good quality forgings under steam hammer in high carbon and alloy steels, and also experienced in Drop Forging and Heat Treatment of such steels.—Apply by letter, giving full particulars of past experience, copies of recent testimonials, age, whether married or single, and salary required, to Box 445, Willing's, Gray's Inn-road, London, W.C. 1. 1278 A

PATTERN MAKERS, PERMANENCY for CAPABLE MEN. District rate.—Apply, F. J. SMITH, 2a, Wynyatt-street, Goswell-road, E.C. 1. 1196 A

SITUATIONS OPEN (continued)

GANGER, Experienced in River Work, Including Sinking Heavy Ferro-concrete Caissons to considerable depth in soft and treacherous ground, REQUIRED for abroad; must be first-class.—Address, giving particulars of experience and salary required, 1241, The Engineer Office. 1241 A

YOUNG MEN of Good Physique (Single Preferred) REQUIRED for service abroad as APPRENTICE DRILLERS with an important English Oil Company. Intending applicants for these positions must be between the ages of 19 and 23, and preferably had two or three years' experience in the Machine or Blacksmiths' Shop of an Engineering Works. Preference given to applicants having had experience in the manufacture of Crane Building, Haulage Machinery, and/or Oilfield Drilling Equipment. Three years' contract in first instance, further two years at option of company. Commencing salary £150 per annum, free board and quarters, rising to £200 third year.—Applications in the first instance must be by letter, giving full particulars of experience, age, and copies of recent testimonials, to Box 444, Willing's, Gray's Inn-road, London, W.C. 1. 1277 A

SITUATIONS WANTED

A CAPABLE INDUSTRIAL CHEMIST and TECHNOLOGIST DESIRES APPOINTMENT. Expert in electro-chemical processes; has held highest technical and executive appointments. Representation in a technical capacity also entertained with company affording scope and wide prospects.—Address, P1367, The Engineer Office. P1367 B

ASSISTANT MANAGER (32), Specialising in Sales, experienced in engineering, contracting, factoring, and buying, DESIRES progressive POSITION with firm of good standing.—Address, P1377, The Engineer Office. P1377 B

ELECTRICAL ENGINEER, Age 25, at Present in test dept. of large manufacturing company, WANTS a POSITION anywhere abroad. Powerhouse, general electrical and some automobile experience, technical education.—M. TUTTON, 30, Devonshire-road, Palmers Green, N. 13. P1383 B

ENGINEER, Mechanical (33), C.G.I. Diploma, Compressed air specialist, with sound steam and oil experience, practical, technical and commercial, SEEKS progressive POST, home or abroad.—Address, P1379, The Engineer Office. P1379 B

ENGINEER, with Practical and Theoretical Experience, also full knowledge of plant for production of artificial silk and finishing same, DESIRES POST with progressive firm manufacturing a similar product.—Address, P1376, The Engineer Office. P1376 B

ENGINEER (39), M.I. Mech. E., A.M.I.N.A., 1st Class B.O.T., ex-Capt. R.E., DESIRES responsible APPT., home or abroad. Wide exp. superintendence, survey, maintenance and repairs to ships, dredgers, machinery and boilers, also considerable office and administrative experience.—Address, P1382, The Engineer Office. P1382 B

EXPERIENCED ENGINEERING DESIGNER DESIRES POSITION, Chief, Assist., or Senior; 15 years trade, jig, tool and general; capable, energetic, initiative and ideas. Mod. salary.—Address, P1385, The Engineer Office. P1385 B

GENERAL MANAGER and CONSULTANT, Thirty years' successful technical experience with well-known mechanical engineering firms in the Midlands and North, OPEN for RE-ENGAGEMENT; free very shortly.—Address, P1391, The Engineer Office. P1391 B

MACHINE SHOP SUPERINTENDENT, 15 Years' exceptional references, REQUIRES CHANGE.—Address, P1388, The Engineer Office. P1388 B

TWO Young ENGINEERS, with Exceptional Experience of MATERIALS HANDLING PLANTS, both commercial and technical, DESIRE to NEGOTIATE with a STRUCTURAL STEEL WORK FIRM of good repute CONTEMPLATING a NEW DEPARTURE.—Address, P1368, The Engineer Office. P1368 B

WELL-EDUCATED YOUTH (Age 17), Just Left school, WISHES to ENTER the OFFICE of a STRUCTURAL or CONSTRUCTIONAL ENGINEER. Small salary after probation.—D., 150, Eltra-road, Wimbledon, S.W. 19. P1378 B

DRAUGHTSMAN (Mechanical), 22, SEEKS Progressive POSITION in London; 3½ years in machine shop, with 4½ years in D.O. Used to design and detail.—G. W., 175, Vauxhall Bridge-road, Westminster, S.W. 1. P1375 B

DRAUGHTSMAN (Senior) SEEKS CHANGE. Fully experienced in general engineering and conversant with up-to-date methods of production. Responsible position required.—Address, P1392, The Engineer Office. P1392 B

ENGINE DRIVER, 10 Years in Charge Last Situation, DESIRES similar POST in or near London. Excellent references.—Address, P1372, The Engineer Office. P1372 B

PARTNERSHIPS

IF YOU ARE SEEKING

A PARTNER or PARTNERSHIP

or wish to buy or sell a

BUSINESS or WORKS

Write:

WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 70 years.

CAPITAL PROCURED for Private Companies by retired bank official from clients prepared to invest £2000 to £5000 as non-active or active directors. Proofs available of investments amounting to over £300,000 made by clients. Fee on completion.—Write, Box 117, Pool's Advertising Service, Ltd., 180, Fleet-street, E.C. 1243 C

PARTNERSHIP.

SPLENDID OPPORTUNITY for a Good Practical Man as MANAGING PARTNER, with capital, in a well-established General Engineering Business in West of England. Turnover seven to ten thousand per annum.

Full particulars from Messrs. DUNN and BAKER, Solicitors, Exeter. P1371 C

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter. B.Sc.), and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Eng. London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 8/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Telephone No. 1118 Bank. EX. B

LEARN SURVEYING and LEVELLING.—Thorough practical instruction by expert.—E. MOUL (late L.S.W. and S.P.D. Rlys.), Hollybank, Woking. P1334 E

AGENCIES

ENGINEER, A.M.I. Mech. E. (Newcastle Office), with sound technical and practical experience in mechanical and general engineering, also good commercial experience, REQUIRES CONSULTING WORK and TWO or THREE additional AGENCIES to firms of good repute.—Address, P1390, The Engineer Office. P1390 D

FIRM Specialising in High-class Vertical Steam Boilers DESIRES to NEGOTIATE SELLING AGENCIES with established firms at home and abroad. Standard sizes stocked and special terms quoted large buyers.—Address, 1219, The Engineer Office. 1219 D

GENTLEMAN, with Established Connection (Technical and Commercial) among Engineers, Shipyards, Steel Works and Collieries on the North-East Coast, is OPEN to REPRESENT first-class FIRM.—Address, 1296, The Engineer Office. 1296 D

LIVE and Energetic Experienced GENTLEMAN (33), resident in Sheffield, SEEKS AGENCY for that district.—Address, P1393, The Engineer Office. P1393 D

AGENCIES.

MIDLAND COUNTIES.—ENGINEER REPRESENTATIVE, with offices in Birmingham and already representing three old-established firms, WISHES to INCLUDE ONE or TWO more FIRMS of repute and who desire to develop their business amongst power stations, consulting engineers, architects, and industrial works, &c.—Address, P1381, The Engineer Office. P1381 D

PROVINCIAL SALES AGENTS REQUIRED for Electric Vehicles, Trucks, &c.—ELECTRICARS, Ltd., Landor-street, Birmingham. 1290 D

TESTING MACHINES.

AGENT WANTED to SELL MY TESTING MACHINES and APPARATUS.—Reply to Dr.-Ing. G. WAZAU, Oslo, Norway, giving full credentials. 1317 D

TRAVELLERS WANTED to Sell Patent Pipe and Nut Wrench in provinces to users. Not necessarily whole time. Liberal commission, no expenses.—Write, THURLEY GRIP-ALL CO., Ltd., 209, New Cross-road, London, S.E. 14. 1275 D

PATENTS

PATENT YOUR INVENTIONS, Trade Mark Your Goods. Advice, handbooks, and cons. free.—B. T. KING, C.I.M.E. (Regd. Patent Agent, G.B., U.S.A., and Canada), 146a, Queen Victoria-street, London, E.C. 4. 38 years' references. 444 H

TO MOTOR MANUFACTURERS.—The PROPRIETOR of PATENT No. 199,752 is DESIROUS of ENTERING into NEGOTIATIONS for the GRANT of LICENCES to Manufacturers on royalty or otherwise or to treat for the SALE of the PATENT OUTRIGHT.—Particulars will be furnished on application by A. M. and WM. CLARK, 53 and 54, Chancery-lane, London, W.C. 2. 1285 H

THE PROPRIETOR of BRITISH PATENT No. 126212, dated January 16th, 1912, relating to "Machine for Making Hairpins," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms, for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Ill. 1198 H

THE PROPRIETOR of BRITISH PATENTS Nos. 135,362 and 139,551, both dated January 10th, 1919, relating to "Improvements in Machine for Forming Hairpins or Similar Articles" and "Improvements in Machine for Counting and Arranging Hairpins or Like Forked Articles," respectively, is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms, for the purpose of exploiting the above patents and ensuring their practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Ill. 1200 H

THE PROPRIETOR of BRITISH PATENT No. 107,559, dated March 30th, 1917, relating to "Improvements in Power Hacksaw-Machines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms, for the purpose of exploiting the above patent and insuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 1193 H

THE PROPRIETOR of BRITISH PATENT No. 140,186, dated February 25, 1919, relating to "Improvements in Lock Nuts and the Method of Constructing the Same," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Illinois. 1255 H

THE PROPRIETORS of LETTERS PATENT No. 178,956, relating to "Improvements in or relating to Compressors," DESIRE to DISPOSE of their PATENT or to GRANT LICENCES to interested parties on reasonable terms for the purpose of EXPLOITING the same and ensuring its full commercial development and practical working in this country.

Enquiries to be addressed to CRUIKSHANK and FAIRWEATHER, Chartered Patent Agents, 65-66, Chancery-lane, W.C. 2. 1256 H

THE PROPRIETORS of LETTERS PATENT No. 183,498, relating to "Improvements in Locomotives," DESIRE to DISPOSE of their PATENT or to grant LICENCES on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.—Enquiries to be addressed to CRUIKSHANK and FAIRWEATHER, Chartered Patent Agents, 65-66, Chancery-lane, W.C. 2. 1273 H

THE PROPRIETOR of BRITISH PATENT No. 151,901, dated March 17, 1920, relating to "Improvements in Mixers for Mixing Sand in Foundries," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. P1319 H

FOR HIRE

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—R. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 978 Hop. 822 K

FOR SALE or HIRE, ELECTRIC MOTORS, from 60 to 300 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 37, Queen Victoria-street, London, E.C. Tel., City 3938. EX.

For continuation of Small Advertisements see page 3.

BRIDGE

BRITISH ROPEWAY ENGINEERING Co., Ltd.,
14-18, HOLBORN, E.C. 1.
Tels.: 5568 HOLBORN
Telegrams: BOXHAULING SMITH-LONDON.
SEE ILLUSTRATED ADVT. LAST & NEXT WEEK

A Seven-Day Journal

Japanese Naval Programme.

OWING to reasons of finance, the large Japanese naval replacement programme which was to have been put into effect this year has been deferred for another twelve months, save that a beginning is to be made at once with the building of new destroyers. The original scheme provided for the construction of forty-two vessels, namely, four 10,000-ton cruisers, twenty-five destroyers, ten submarines and three special ships, and was to have been spread over a period of five years, from 1926 to 1930. The intention is to substitute new vessels for the "Tone" and the three "Hirado" class cruisers, as well as for the third-class destroyers, which are now over twenty years old. The new cruisers are to be units of the "Nachi" class, armed with nine 8in. guns; the destroyers will be 100 tons heavier than those now being built; and the submarines will displace at least 1500 tons. During the present financial year, however, new construction will be limited to four destroyers, for which a sum of 8,000,000 yen is included in the Budget. An additional 18,000,000 yen is to be spent on new ships, beginning with the new financial year which opens next July. This expenditure is entirely distinct from that which is being incurred by the building and completion of vessels authorised before the new programme was drawn up. Among such vessels are six large cruisers, a dozen or more destroyers, many submarines and some fleet auxiliaries. The Japanese Press is urging the Government to order most of the new ships from private yards, which have suffered severely as a result of the naval limitations. Apart from new construction, the Japanese Fleet has been strengthened during the past two years by the modernisation of its capital ships, most of which have undergone extensive alterations designed to improve their fighting value.

The Transmutation of Metals.

MERCURY, as we have noted previously, was the favourite element of the old alchemists in their search for a method of producing gold. Those who to-day are studying the transmutation of metals still seem attracted by the *argentum vivum* of the ancients. It was in a mercury vapour lamp that Professor Miethe, of Berlin, in 1924, discovered, or claimed to have discovered, particles of gold after current had been passed through it for a prolonged period. It was by the bombardment of a mercury electrode with a heavy electric discharge for ten to fifteen hours that Mr. Nagaoka and his colleagues at Tokyo obtained signs which led them to believe that a minute quantity of the mercury had been transformed into gold. Now we hear of a further attempt at transmutation by Drs. Smits and Karssen, of the University of Amsterdam, whose earlier work will be recalled by some of our readers. Particulars of the apparatus and method employed will be found in last week's issue of our esteemed contemporary *Nature*. It is sufficient here to say that lead heated in vacuo to redness was introduced in the liquid state into a special form of quartz lamp, kept hot by gas burners, and was there subjected to either a continuous or a spark current of high density. The lead and all the materials used in the experimental apparatus were examined spectroscopically before the work was begun, and all failed to show the presence of mercury or thallium. After half an hour, 2¾ hours, 8¾ hours, 12 hours, and, finally, 39 hours of sparking, the lead was examined spectroscopically. On each successive occasion the characteristic lines of the mercury spectrum became, first visible, and then more and more pronounced, until at the last examination they were found to be almost completely reproduced. Certain of the thallium lines were also observed to develop. A second method involving the passage between two lead electrodes of sparks at a voltage of 100,000 for 12 hours was tried. An extremely sensitive reaction, when applied to the product, gave, it is stated, very distinct signs of the presence of mercury, although the same reaction had failed entirely to detect mercury in the original materials.

A Gyroscopically Controlled Aeroplane.

SINCE the earliest days of aeronautics almost continuous efforts have been made to devise a satisfactory form of automatic control that would relieve the pilot of an aeroplane of much of the constant labour and care required to preserve the machine in a given flying attitude. The control commonly sought relates to the ailerons and elevators, and not to the rudder; that is to say, it is desired to leave the pilot with complete control over the course of his machine, but to relieve him of the duty of constantly correcting the effect of forces tending to disturb the trim about the longitudinal and transverse horizontal axes. There are many pilots who dislike the idea of the control of any of the flying organs being taken out of their charge, and there are many designers who believe that the true principle to follow is to make the machine inherently stable by virtue of its aerodynamic design, and not to rely on any mechanical stabilising means carried on board the craft. Much may be said on both sides, but without entering into a discussion, it need here only be remarked that when night flying is under consideration, the claims made on behalf of automatic control are strengthened rather than weakened by the exigences of such flying. Among the many schemes advanced to secure the automatic control of aeroplanes, the use of a gyroscope in some form or other has been a prime favourite, although one system that was fitted and tried on some Handley Page machines—the Aveline automatic pilot described and illustrated in our issue of February 18th, 1921—made no use of gyroscopes, but employed instead a system of mercury levels which when the mercury was disturbed by rolling or pitching movements established certain electrical contacts, and thereby led to the ailerons or elevators being automatically actuated by compressed air. We understand that the huge Vickers-Rolls-Royce "Vanguard" passenger machine for Imperial Airway, Ltd.—illustrated in one of our Supplements last week—is being equipped by the Department of Civil Aviation with a gyroscopic control system, with the object of facilitating its flight by night. The system is not a proprietary invention, but has been evolved by the Royal Air Force technical staff. The gyroscope will be driven by compressed air supplied by a windmill motor, and will act on the rudder only. In use it will serve to preserve the machine on a given straight course. It was hoped at one time to apply a second gyroscope to control the ailerons, but this part of the scheme has been abandoned, at least for the time being.

Wireless Communication.

IN a circular issued to the shareholders of Marconi's Wireless Telegraph Company on January 1st, it is stated that the negotiations with the Postmaster-General concerning a licence for the conduct of telegraph services between Great Britain and foreign countries have been brought to a satisfactory conclusion, and that the agreement embodying the terms of the licence has been signed. In addition to the services which the company has been conducting with France, Spain, Switzerland, Austria and the United States, it is now licensed to conduct services with Denmark, Sweden, Finland, Russia, Portugal, Jugo-Slavia, Bulgaria, Turkey, and Greece, and with all foreign countries outside Europe. The beam stations which the company is erecting for the British Government and for the Governments of the Dominions and India are making satisfactory progress. It had been hoped that the Canadian and South African stations would be ready for working by the end of 1925, but their completion has been delayed by the illness of Senatore Marconi and Mr. Franklin. The preparation of the company's case for submission to arbitration in connection with its claims against the Government for the use of its patents by the fighting forces before, during and since the war has made a considerable advance, but the amount of work involved is so great that it is impossible, the circular states, to give any definite date when it will be completed.

Repairing Lincoln Cathedral.

THE account of the repairing work now being carried out at Lincoln Cathedral, which was given by Sir Charles A. Nicholson and Sir Francis Fox at Monday evening's meeting of the Royal Institute of British Architects, was a narrative not without interest to engineers. The early repairs were referred to and particular mention was made of the heavy wrought iron cramps which were introduced in 1820. The destruction which was produced in the masonry by this wrought iron was almost incalculable, for the iron used had a laminated structure, and when corrosion took place the laminations gradually opened, so that by the slow expansion of the iron masses of masonry were lifted and broken off. In the timbers of the north-west tower and in other parts of the Cathedral the "death-tick" beetle was discovered, but much of the wood structure had been replaced by reinforced concrete. By the use of an improved method of pressure grouting, combined with modern pneumatic hammer drilling and the employment of high-tensile bronze cramps, considerable progress had been made, and it was hoped that by 1927 all the major repairs would be completed. Sir Francis paid high tribute to the workmen and to the excellent tools available for their use. In some places it had been possible, he said, to do in one hour and for 1s. work which twenty years ago would have taken a week and would then have cost a pound. The work is being carried on by the direct labour of specially trained local workmen, and it is computed that never before has cathedral repair work been accomplished more quickly and with such efficiency and economy.

Diesel Engine Users' Association

IN the secretarial statement of the Diesel Engine Users' Association for 1925, which reached us a few days ago, reference is made to the probable future use of oil engines in conjunction with steam plants and for peak load working in the case of large schemes for bulk supply. In this connection it is of interest to note that for the fourth year the Association has compiled and published its report on heavy oil engine working costs. This report is now available in complete form along with the discussion. Particulars are given of the actual working costs of thirty-six Diesel and hot-bulb installations in the United Kingdom and of eight overseas oil engine generating plants. With an average annual plant load factor of 15·3 per cent. the average total engine cost for the home installations, with a total output of about 32,000,000 units, was 0·806 of a penny per unit generated. In the case of the overseas stations, with a total output of about 18,000,000 units, the average figure was 0·746 of a penny per unit generated. It is necessary to bear in mind, however, that these are average figures obtained from the working of undertakings under all kinds of conditions, often by no means favourable to obtaining the best results. This remark also applies to the figures given for the repairs and maintenance cost per annum for over 100 engines of all sizes in home installations, which worked out at £0·767 per kilowatt of plant installed. In the discussion of the report it was stated that in some industrial heavy oil installations the annual cost of repairs and maintenance did not exceed a figure of between 4s. and 6s. per brake horse-power per annum. In an appendix to the report comparative running costs for steam and oil engine-driven pumping plants in Egypt are given. Mr. E. W. Johnston, of King's College Hospital, is to be president of the Association for 1926, and Mr. Percy Still and Mr. Geoffrey Porter are re-elected joint honorary secretaries.

British Railways and British Materials.

IT is announced that the London and North-Eastern Railway has decided that in all future contracts for goods produced from steel, a clause will be inserted specifying that the articles must be of British manufacture and made from steel of British manufacture throughout. The new clause, it is understood, will particularly affect the supply of such articles as carriage and wagon axles, tires, springs and buffers. This action on the part of the London and North-Eastern Railway, while it is greatly to be commended, does little more than make definite a practice which has been followed whenever possible by all our railways in recent times. For instance, on the Southern Railway, all the steel required for the electrification and other schemes of improvement now in hand has been purchased in this country, and it is intimated that this policy is to be continued. Quite recently the Great Western Railway took steps to revise contract specifications to give a definite ruling in the matter, while on the London, Midland and Scottish system it has been a settled practice for some time past not to purchase material outside the country if home sources of supply were available.

The Wireless Section of the Institution of Electrical Engineers.

THE proposal to form a new Institution of Wireless Engineers has given rise to a good deal of discussion. In the opinion of the Committee of the Wireless Section of the Institution of Electrical Engineers a new institution is quite unnecessary, and it feels confident that it will not be supported by representative and qualified professional wireless engineers. The Institution of Electrical Engineers has explained that an engineer with adequate wireless qualifications can become a corporate member, and that others not reaching that standard are eligible as graduates, and can attend all the wireless and other meetings. With a view to improving and extending the activities of the Wireless Section of the Institution of Electrical Engineers, the Committee recently submitted the following recommendations, which were approved by the Council of the Institution:—(1) While it is essential that the standard of qualifications for membership of the Institution should be maintained, more opportunity is to be afforded to the physicist engaged in wireless work to become a member of the Institution. (2) The qualifications for membership of the Wireless Section are to remain as at present. The Wireless Section Membership Sub-committee is to scrutinise all new applications for membership and decide who shall be admitted to it. (3) It is to be emphasised and made more widely known that all meetings of the Wireless Section are open to all members of the Institution. (4) The Wireless Section Committee is to get into direct touch with the local centre committees for the purpose of ascertaining the possibility of starting local wireless sections, stimulating the effort to produce local wireless papers, and suggesting the reading of available suitable papers or of giving lectures at local centres. (5) Each wireless section, when properly constituted, is to be entitled to elect or nominate one wireless member to the Wireless Section Committee, and for this purpose a local wireless section will consist of at least fifteen members, who must already be members of the main Wireless Section. (6) In addition to appearing in the *Journal* of the Institution, the papers and discussions of the Wireless Section are to be issued separately in the form of "Proceedings of the Wireless Section"; and (7) as soon as the necessary alterations to the by-laws can be made the chairman of the Wireless Committee must be an *ex-officio* member of the Council.

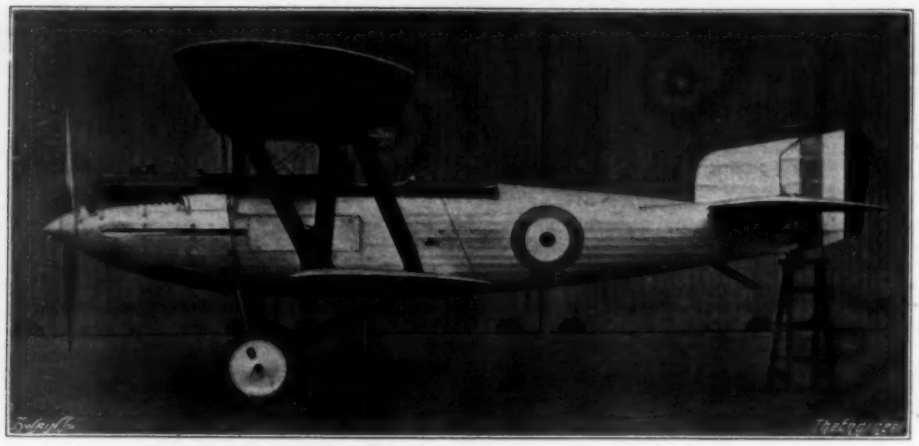
Aeronautics in 1925.

No. II.*

WE continue below our account of the work undertaken during the past year by British firms engaged in the aeronautical industry.

Some Additional Military and Civil Aeroplanes.

The Fairey Aviation Company, Ltd.—One of the outstanding machines of the year was undoubtedly the Fairey "Fox" day bomber produced by the Fairey Aviation Company, Ltd., of Hayes, Middlesex. This machine, illustrated herewith, was, the makers tell us, the outcome of a decision by Mr. C. R. Fairey to get away from accepted routine, and, at his own risk and without the preliminary support of any official order, to lay down plans for a day bomber with a performance definitely ahead of that of any other machine of its class. The machine, as produced under these conditions, is, we understand, the fastest bombing aeroplane in the world. Its speed, in fact, is in excess of that of a standard single-seater scout, from which it may be inferred that it is something over 150 miles an hour. The type is now being supplied in large numbers to the Royal Air Force. It is, indeed, no secret that thirty "Fox" bombers have been ordered by the Air Ministry for a newly formed experimental flight to be equipped exclusively with high-speed machines.



THE FAIREY "FOX" DAY BOMBER

The machine, as will be gathered from our illustration of it, is a two-seater. Its deep narrow fuselage is of remarkable stream-line form throughout. The engine is a Curtiss D 12—to be known, apparently, in this country as the Fairey "Felix" D 12—of 400 horse-power. It is generally understood that the machine was more or less built round the engine, and that no British engine of similar power was available that would have permitted the designer to streamline the nose end in the manner desired within the dimensions imposed by the narrow width of the fuselage. Criticism has been directed against the Air Ministry for placing a considerable order for machines of a type embodying an American engine, but with the history of the design fully understood, such criticism seems misplaced.

The machine is equipped with a two-bladed Fairey-Reed metal air screw. Metal, we infer, also enters largely into the general construction of the body, wings, &c. Other aircraft with performances in keeping with the standard set by the "Fox" are now being experimented with by the firm.

Of the Fairey "Fawn" and the Fairey "Flycatcher," both of which we illustrated in our review of aeronautics in 1923, we can still say but little, for they are in continued production for the Royal Air Force. The "Fawn" is a three-seater Army reconnaissance machine, which at a few moments' notice can be converted into a day bomber. It is driven by a Napier "Lion" engine, and, like most Fairey designs, is fitted with the makers' patented arrangement for varying the camber of the wings. The "Flycatcher" is a single-seater scout, fitted with a Siddeley "Jaguar" engine or with a Bristol "Jupiter" as an alternative. It is made either as a deck-landing machine or as an amphibian, with a twin-float undercarriage. It has a very high top speed, but its landing speed is low, as a result of its equipment with the Fairey variable camber gear. The air controls are, it is stated, effective below the stalling speed of the machine.

The Fairey III. D seaplane, to which we have made reference in previous reviews, continued in production during the year. It is a general service machine for bombing, reconnaissance, gunnery spotting, and other work, and is being used for some commercial purposes. A seaplane of this type was recently supplied as an ambulance machine to an undertaking in British Guiana for conveying sick workpeople to hospital from estates in the interior. By means of it, a journey which formerly by road and water occupied seventeen days, has now been reduced to one of two hours. A seaplane of the Fairey III. D type secured the Britannia Trophy for 1924 by flying a distance of 8568 miles round Australia in ninety flying hours.

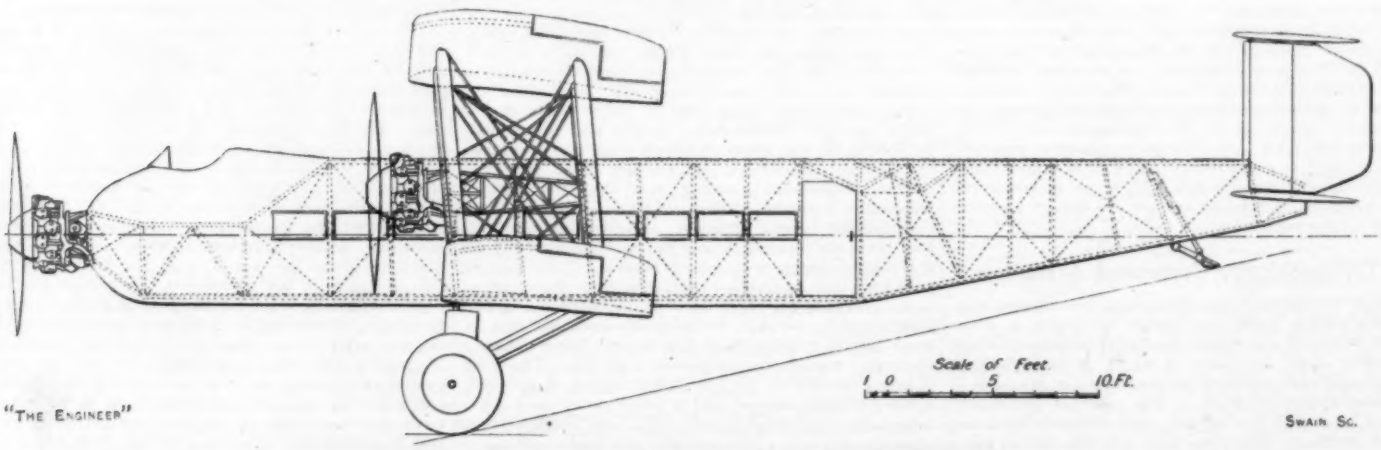
Hawker Engineering Company, Ltd.—The production of machines for the Royal Air Force occupied throughout the year the close attention of the H. G. Hawker Engineering Company, Ltd., at its Kingston-on-Thames works. Among the types delivered was the "Woodcock," a high-performance single-seater fighter, driven by a Bristol "Jupiter" engine. This machine is particularly intended for night flying work, and to that end the cylinder exhaust pipes are led into a ring in which the flame is damped out before the gases are finally ejected beneath the fuselage. Another design of single-seater fighting scout, the manufacture of which was a feature of the firm's work during the year, was the "Heron"—illustrated herewith. This machine is distinguished by its high rate of climbing, and by the fact that its structural details are all carried out in metal. The construction of the metal parts is understood to embody some entirely new principles, and to possess the desirable characteristic of simplicity. The engine is a Bristol "Jupiter." The Hawker "Hedgehog," also produced during the year, is a machine of quite a different type,

THE HAWKER "HERON" SINGLE-SEATER FIGHTER

THE HAWKER "HORSLEY" DAY BOMBER

with a performance definitely ahead of that of any other machine of its class. The machine, as produced under these conditions, is, we understand, the fastest bombing aeroplane in the world. Its speed, in fact, is in excess of that of a standard single-seater scout, from which it may be inferred that it is something

although its power equipment—a 400 horse-power Bristol "Jupiter" engine—is the same. This machine is a three-seater biplane, and was designed specifically for operating with the Fleet on reconnaissance duties. It carries a high military load, and has a wide range of action. In the execution of deck landings, it has, we learn, proved very successful. The "Horsley" day bombing machine, stated to be the latest type of this class, with which the Royal Air Force is being equipped, may not be described at present. We are, however, permitted to publish an illustration of it herewith, and to state that it is driven by a Rolls-Royce Condor engine of 650 horse-power.



THE ARMSTRONG-WHITWORTH "ARGOSY" THREE-ENGINED PASSENGER MACHINE

* No. I. appeared January 1st.

Apart from these service machines, the Hawker Company was fortunate in securing an order from the Royal Danish Navy for a batch of single-seater fighters, driven by Siddeley "Jaguar" Mark IV. engines. The "Cygnet" light aeroplane, driven by a small Anzani engine, of which we gave some details in our previous annual review, increased its reputation during the summer by winning the International 100 Miles Handicap and by securing second place in the height contest.

Armstrong, Whitworth Aircraft, Ltd.—At the Coventry Works of Sir W. G. Armstrong, Whitworth Aircraft, Ltd., besides the manufacture of the now well-known "Siskin" type of fast single-seater aeroplane, a new design, the "Ajax," was produced during the year. This machine—illustrated on page 44—is a general purpose two-seater aeroplane, designed to carry a useful load of 1000 lb., together with four hours' supply of petrol. It is driven by an Armstrong Siddeley 380 horse-power "Jaguar" engine, and has a speed near the ground of 145 miles an hour. Special attention has been paid to securing a low landing speed and a quick pull up after the machine touches the ground. The Armstrong "Argosy," of which a line drawing is reproduced, was designed during the year, and is now nearly completed. It is a triple-engined biplane, intended to carry a useful load of 2 tons, and is equipped with seating accommodation for twenty passengers. Two luggage compartments are provided, one in front of and one behind the passengers' cabin. The engines are of the "Jaguar" type, and it is intended that the machine shall be able to fly with a full load on any two of them. The top speed of the machine is expected to be 110 miles an hour and the cruising speed 90 to 95 miles. When completed the machine will be delivered to Imperial Airways, Ltd. During the year the firm continued to devote attention to the manufacture of aeroplanes with steel frameworks. The manufacturing processes were improved, and progress was made towards the production of aeroplanes of increased strength and decreased weight. The firm claims to be the only one in the world which has produced aeroplanes in quantity in which all the framework of the wings and bodies are of steel. It does not consider the use of aluminium alloys advisable, but on this point it may be remarked that those who favour the use of such alloys argue that steel for certain purposes in the structure of aeroplanes is definitely inferior to aluminium alloys.

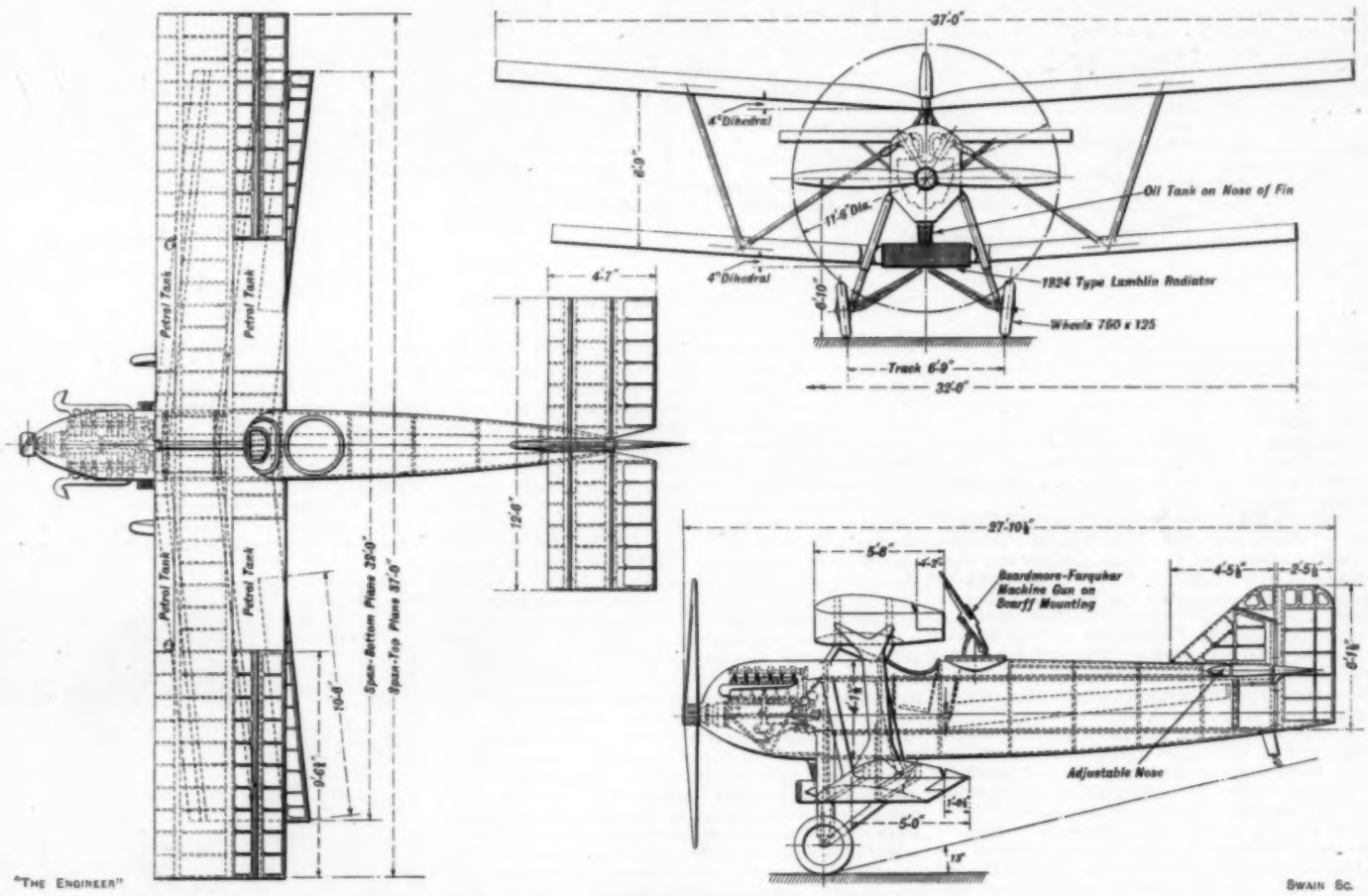
The Gloucestershire Aircraft Company, Ltd.—The work of the Gloucestershire Aircraft Company, Ltd., of Cheltenham, consisted of the development of the "Grebe," "Grouse" and "Gannet" types, and the production of three new designs. Among the existing types, the "Grebe"—illustrated in our issue of January 11th, 1924—had its power increased to 420 horse-power by the installation of a Bristol "Jupiter" engine. This machine is a fast single-seater, high altitude fighting scout. With the "Jupiter" engine the rate of climb has been slightly increased. As the machine is a good example of its class, we give below some details of its performance.

Gloucestershire "Jupiter Grebe."

Maximum speed	149 m.p.h.
Speed at 10,000ft.	144 m.p.h.
Landing speed	53 m.p.h.
Ceiling	23,500ft.
Time to climb to 20,000ft.	23 min.
Duration at 15,000ft.	2¼ hours
Petrol consumption per hour	29 gallons
Oil consumption per hour	2 gallons

Of the new types produced during the year two, the "Gamecock," a single-seater fighter, with a 420 horse-power Bristol "Jupiter" engine, and the "Gorcock," a single-seater fighter, with a 450 horse-power Napier "Lion" engine, have not yet reached the stage at which it becomes permissible to publish details of their design. The third new type was the "Gloster III." single-seater racing seaplane, which was entered for the Schneider Cup contest at Baltimore in October. With the mishap to the Supermarine Napier 84 machine, the "Gloster III." was the sole British representative to take part in the contest. It achieved an average speed of a fraction over 199 miles an hour, and was placed second in the race. A photograph of the machine is reproduced on page 44. Unlike the "Supermarine" racer, some details and illustrations of which were given in our issue of October 16th, the "Gloster III." is a biplane and not a monoplane. It is driven by a Napier "Lion" engine, modified for racing purposes. The body is oval section, and is constructed on the "Monocoque" principle, with wooden longitudinals and a three-ply outer covering. It is stated that the machine is probably the smallest for its horse-power that has as yet been produced with floats. The carefully stream-lined body in fact just provides the bare amount of room to permit the pilot to be seated comfortably. The wings are built of spruce spars and ribs, and the fabric is attached by a method designed to withstand the suction produced at the high speed at which the machine flies. The propeller, driven direct by the engine, is of solid duralumin, for wooden propellers, it is stated by the makers of the machine, would not stand up to the work required of them. Duralumin is also used for the construction of the floats, which are attached to the body by stream-lined struts and wires. The radiators, of an unusual type, are built into the leading edge of the lower wings near the body. The firm, we learn, is now experimenting with machines of all-steel construction.

William Beardmore and Co., Ltd.—A very interesting design of two-seater fighting aeroplane, of which we give a general arrangement drawing herewith, was produced during the year by William Beardmore and Co., Ltd., Dalmuir. The biplane type was chosen, Messrs. Beardmore informs us, in preference to the monoplane, because of its greater rigidity and manœuvrability and lower weight. At the same time an endeavour was made to equal the aerodynamic efficiency of the monoplane by employing a high gap-to-chord ratio and a high aspect ratio, and at the same time completely dispensing with external bracing wires. It is claimed that the machine as constructed gives a better field of view than is possible in a monoplane, and is much more easily controlled by reason of its reduced moment of inertia about the longitudinal axis. The wings are braced by three struts on each side, and are pin-jointed to the body to facilitate detachment and re-assembly. In accordance with what experience has taught the makers to be essential in a fighting aeroplane, the pilot and gunner are placed as close as possible together. The pilot controls two fixed Beardmore-Farquhar machine guns firing through the propeller and fitted with the Constantinesco fluid interrupter gear. A similar machine gun mounted on a Scarff ring is operated by the gunner. This gun can be fired through the complete upper hemisphere and at 10 deg. beyond the vertical underneath the fuselage. The fin and tail plane structures are without external wire bracing, and employ only one pair of struts. These struts are situated beneath the tail plane in such a position that they cannot be shot away by the gunner. A feature of the general design of the machine is the fact that no use is made of special grades of steel requiring much skill and care in their heat treatments.



THE BEARDMORE TWO-SEATER FIGHTER AEROPLANE

The details of the wing structure are worthy of note. Each contains two box spars and is covered from the leading edge to the rear spar with plywood, a structure which, it is claimed, provides great resistance against drag forces and torsion. Over the whole wing surface linen fabric is laid at 45 deg. to the leading edge. The method of applying this covering increases the resistance against drag forces and limits the damage done by a tear spreading from a bullet or other hole. The ailerons in the top and bottom planes are operated by direct-acting rods and cables completely enclosed inside the wings. Sliding doors in the wings permit adjustments or replacements to be made in these rods and cables. The two struts running from the body to the bottom wing are made of steel tubing with a duralumin fairing riveted on. The single interplane strut is built up of duralumin plates and is faired off to a stream-line form. Spruce longerons, spruce bulkheads, and a three-ply covering compose the fuselage, the whole of which is subsequently clothed with fabric to protect the joints. It is claimed that the fuselage cannot warp or get out of truth. Two vertical fins projecting from the body and carrying the upper and lower wings are built in one with the fuselage bulkheads, with the object of increasing the rigidity of the wing structure. The under-carriage is constructed throughout of metal. Landing shocks are taken by a patented system of spiral springs in compression through a Ferodo-faced damping gear. This form of landing gear is stated by the makers to be superior to the popular hydraulic

pattern and to any type employing rubber rings. A vertical travel of 9¼in. can be accommodated by the landing gear, a fact which is stated to enable successful landings to be made on extremely rough ground.

The horizontal member of the tail unit is built in three parts, a central fixed portion, an elevator, and a hinged front portion adjustable for angle from the pilot's or gunner's cockpit. By means of the front adjustable portion provision is made for the usual variations in the position of the centre of gravity. In addition, the device permits a neutral feel on the control lever to be secured at all flying speeds, and hence relieves the pilot of much fatigue. The pilot's controls are duplicated in the gunner's cockpit, so that the machine may be flown from either position. In the design of the controls direct-acting rods, cables and torsion tubes only are used, no pulleys being employed on the ground that they are considered crude and dangerous.

The engine, a 375 horse-power Rolls-Royce "Eagle," drives a wooden propeller, 11ft. 6in. in diameter, protected with metal at the leading edges and tips. A radiator of the "Lamblin" type is attached to the projecting fin supporting the bottom plane in a position stated to ensure the best cooling effect and the minimum amount of resistance without in any way obscuring the pilot's view. Petrol is fed to the engine by gravity from two large tanks mounted in the top plane and shaped to conform with the wing section. The machine, it is estimated, will have a maximum, or ground level, speed of 145 miles an hour and a landing speed of 57. Its climbing speed is given as 15,000ft. in 20 minutes, and its ceiling at 20,000ft. With a petrol capacity of 75 gallons, its duration should be about four hours at cruising speed.

George Parnall and Co.—The Parnall "Plover" single-seater fighting machine cannot strictly be called an aeroplane of 1925, for it was designed in the spring of 1923. We illustrate it herewith—see also page 44—however, because until quite recently it was not permissible to say anything about it. The machine is designed to take off from and alight on the decks of aircraft carriers, and, as shown in the accompanying general section, can be readily converted into an amphibian. It is characterised by the provisions made for giving the pilot a good view downward and right ahead, directions in which it is particularly desirable that vision should be unobstructed in a deck-landing machine. The pilot's cockpit, it will be seen, is situated just behind and below the top rear spar, and with the pronounced stagger given to the wings the downward field of view is considerable. The curved wind screen and the slope of the fairing in front of it facilitate a good forward view. A gun is arranged on each side of the cockpit in such a manner as to be readily accessible should a jamb occur while the machine is in flight. The engine, either a "Jupiter" or a "Jaguar," is permanently bolted to a plate, which in turn is fixed to the engine mounting by four pins, so that the whole may be readily removed and replaced by another engine and plate. Behind the engine plate there is a fireproof bulkhead composed of aluminium sheets, with a layer of asbestos between them. In front of this bulkhead no timber of any kind is used in the construction. The under-carriage, of the firm's patented type, embodies double-acting oil cylinders and rubber blocks. On the downstroke the energy is absorbed partly by the oil and partly by the compression of the rubber blocks. On the upstroke about 90 per cent. of the energy in the rubber is dissipated by the oil. Only a small percentage of the original energy is therefore left to produce rebound. At the tail, skid shock is absorbed by the compression of rubber blocks and not by the stretching of tension cords.

The construction of the flying organs presents some features of considerable interest. The incidence of the tail plane can be adjusted by means of a hand-wheel in the cockpit while the machine is in flight. The tail fin can be adjusted while the machine is on the ground to enable the pilot to fly when he so desires with his feet off the rudder bar. The elevators are balanced to give easy control. In order to facilitate storage on an aircraft carrier the main wings are detachable as units, and when detached each unit is a rigid structure. At the inner end of each unit rigidity in the detached condition is secured by the provision of permanent jury struts running from the bottom front spar to the top front and rear spars. In the assembled condition these jury struts where they project above the body line up with and form the fairing of the fixed centre section struts. Within the body the jury struts are not faired, for they are hidden from the wind. The ailerons extend along the full span of the wings and may be used as flaps to reduce the landing speed. They are controlled by a differential movement in the now familiar manner.

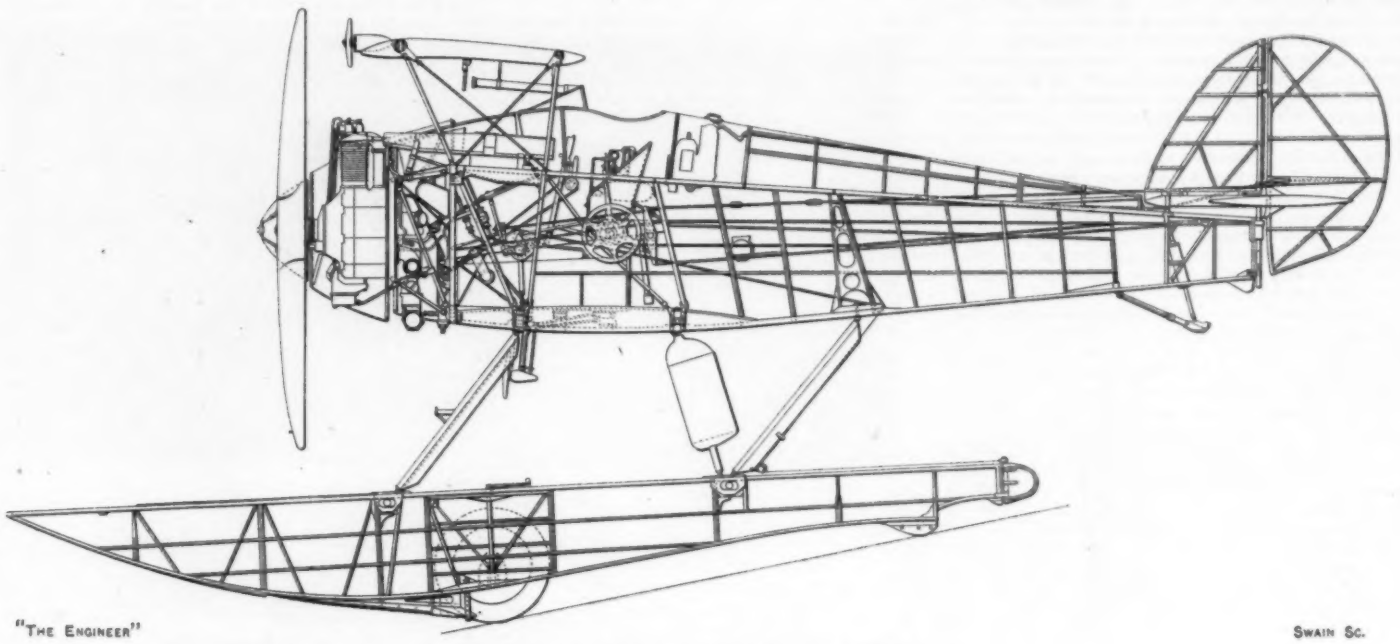
The main supply of petrol is carried in a tank of 46 gallons capacity beneath the pilot's seat. A gravity tank holding 6 gallons is provided in the fairing above the engine. A Vickers wind pump supplies the petrol direct to the engine carburetters. A by-pass is taken to the gravity tank, from which the surplus fuel returns to the main tank by way of an overflow pipe in which a petrol flow indicator is fitted. The arrangements are such that the engine may be fed either from the pump or the gravity tank, or from both together. In addition, there is a hand pump by which the gravity tank can be replenished from the main tank. In case of emergency the contents of the main tank can be quickly discharged through a jettison valve of 3in. bore. With this tank empty the machine becomes buoyant in the water. Its buoyancy may be increased by an air bag fitted in the rear portion of the fuselage. Provision is made for the installation of a gas-starting engine in a compartment closed by a hinged aluminium cover forming part of the fairing immediately behind the cockpit.

To enable the machine to be hoisted, a permanent sling is attached to the fuselage near the fireproof bulkhead. This sling passes through a fitting in the top centre section and ends in a loop for the attachment of the crane hook. In the amphibian form the machine is equipped with two floats having fixed wheels projecting below the bottom near the steps. Each float is provided with a water rudder, which is operated in conjunction with the air rudder from the rudder bar in the cockpit. The oil and rubber shock-absorbing system of the floats is so designed that, at all deflections, the angle of the float-bottom relatively to the machine remains constant, a feature of much value when the machine is rising from water.

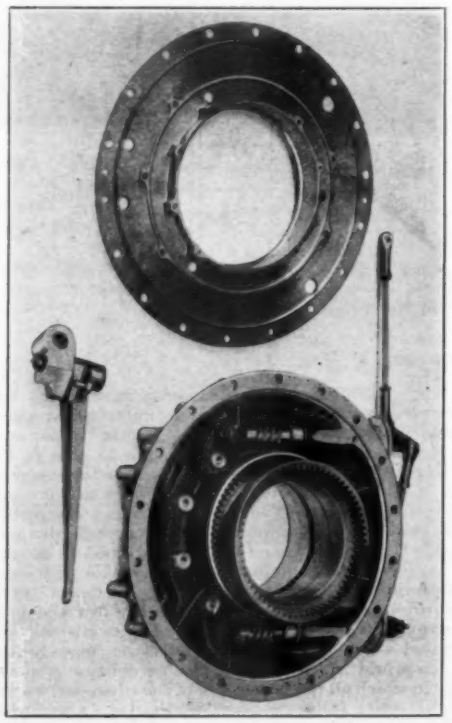
As a land machine and fitted with a "Jupiter" engine, the machine has a speed of 142 miles an hour at 800ft., and of 119 miles at 17,000ft. It can climb to 20,000ft. in 25 minutes 13 secs., and has a service ceiling of 23,000ft. With the wing flaps normal its low speed is 45 knots, and with the flaps down 40 knots. In a 20-knot wind its taking off distance is 14 yards and in a 27-knot wind only 8 yards.

The Bristol Aeroplane Company, Ltd.—Beyond the "Bloodhound" two-seater reconnaissance and fighting machine, a description of which we published in our issue of July 11th, 1924, it is not permissible to publish details of the aeroplanes on the construction of which the Bristol company's works were engaged during the year. It may be said, however, that several new and very interesting types were produced, including some of the all-metal type in the construction of which the company claims to hold a leading position.

The company's engine department, we learn, was a scene of considerable activity, and developments of great importance were achieved. During the past twelve months no less than four of the very exacting 100 hours' type tests of the British Air Ministry were carried out on improved designs of Bristol engines. In connection with the Bristol "Jupiter" engine, many facts must be suppressed in the interests of official secrecy, but it is permissible to give details of one important development, namely, that of the variable timing gear with which the engine is fitted. Towards the end of the war, when it was urgently desired to increase the performance of aero-engines at high altitudes, Mr. Ricardo advanced a scheme making use of a variable timing gear in conjunction with a high compression ratio. Near the ground level the inlet valve would be closed so late that compression would not start until the piston was well up the compression stroke. As the height above the ground became greater the pilot would advance the timing gradually, until at a predetermined altitude normal timing would be reached. By this means the ground level power would be obtained up to the pre-determined height. Thereafter the power would fall off as in an engine of normal compression ratio, but nevertheless there would, it was held, be a consider-



THE PARNALL "PLOVER" SINGLE-SEATER AMPHIBIAN

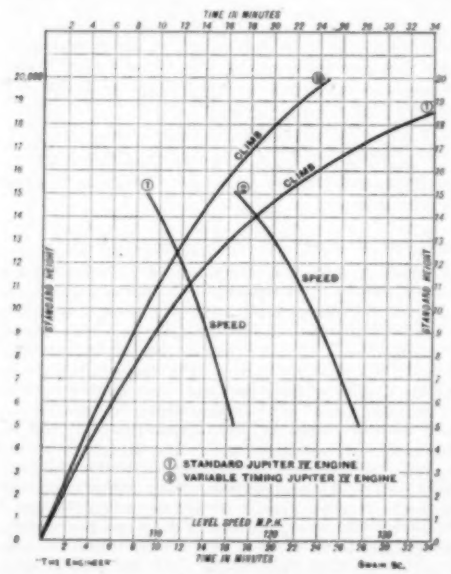


BRISTOL VARIABLE TIMING GEAR

able increase of power available at all altitudes and a marked economy of fuel. It was argued that this scheme was preferable to the employment of an oversized high compression throttled engine in that it gave a rising torque curve, a short compression and a long expansion stroke, absence of risk of pre-ignition and detonation, and other advantages. The method, however, was not developed because, we understand, of difficulties encountered in applying it to existing engines with their cylinders arranged in line.

During the past nine months the Bristol Company has been working on the method as applied to its "Jupiter" engine. That engine permitted a practical solution of the problem by reason of the fact that with its double epicyclic timing gear it is a simple matter to arrange for the time of opening of the valves to be changed while the engine is running, and also because the stroke-bore ratio being 1·3 to 1 it was found possible to re-design the cylinder with a compression ratio of 6·3 to 1 without the production of an inefficient combustion chamber. The results obtained with the method as applied to the "Jupiter" engine have, we are informed, been excellent, both on the bench and in the air. The accompanying engraving of the gear as mounted on the nose of the engine shows that the details added are quite simple. It will be seen that a double worm is applied to control the stationary annulus of the timing gear. No moving parts of the engine are affected, and the added weight is only 4 lb.

On the test bench it was found that the gear could be operated satisfactorily throughout the whole range with very slight effort, and that the ground level power could be maintained at normal consumption. The engine was then fitted into a Bristol "Bloodhound" machine with which very careful performance tests had previously been made when fitted with a standard "Jupiter" engine of 5 to 1 compression ratio. The machine in both conditions had the same weight and the same propeller and was flown by the same pilot.



BRISTOL "BLOODHOUND" TEST RESULTS

The results of the two series of tests are represented in the accompanying diagram. It will be seen that on a climb to 18,000ft. the time is reduced by eleven minutes with the variable timing engine, and that at 15,000ft. the speed is increased by 8 miles an hour. The gear, it is claimed, does not increase the head resistance of the engine, nor detract from its trustworthiness, and adds only 4 lb. to the weight.

During the year licences for the construction of "Jupiter" engines abroad were arranged with firms in France, Italy and Czecho-Slovakia. The French Government alone placed an order for 370 "Jupiters" with the French licencees. Thirteen European Governments now have "Jupiter" engines in their service, while the Dutch K.L.M. commercial aviation company has announced that the whole of its future programme will be based on the use of this design of engine.

Alongside the development of the "Jupiter" engine the company during the year effected improvements in its "Lucifer" and "Cherub" types. The horse-power of the "Lucifer" has been increased 20 per cent. to 120 horse power, and among other developments the engine has been fitted with an atomiser induction elbow, which reduces the consumption and improves the carburation at high altitudes, and with a simple and more efficient form of exhaust silencer. The small "Cherub" engine underwent considerable modification, including an increase of its cylinder capacity to 1228 c.c. Quite recently, in its new form, it underwent successfully the Air Ministry's 100-hour type test at a rating of 29 horse-power, with a maximum of 35·4 horse-power.

Airships.

While interest in the development of airships was stimulated in this country by the experiments conducted with the reconditioned R 33—experiments designed to furnish data of assistance in the construction and operation of the two 5,000,000 cubic foot airships now being built—it was seriously checked in the United States by the disaster which overtook the helium-filled airship "Shenandoah." On the whole, the airship cannot be said to have emerged from the year with much additional credit attached to it, at least in the popular estimation. The loss, on September 3rd, of the "Shenandoah," involving the deaths of 14 out of the 42 men on board, was primarily due to the fact that the vessel encountered an unexpected storm of great severity, and secondarily to the fact that the steps taken to prevent an excessive loss of the valuable gas with which she was charged, reacted adversely on the facility with which the craft could be controlled. But whatever excuses may be made the fact impressed upon the public was that an airship reputed to be of modern and improved design, and filled with a gas, the nature of which eliminated an ever present risk of disaster in all previous vessels of her class, suffered complete disaster. So, too, in the case of our own airship, the R 33, the fact that on April 16th this vessel, with a nucleus crew on board, was torn away in a gale from her mooring mast at Pulham, and in a badly damaged condition was driven over the North Sea and did not return for 30 hours, offset much of the favourable impression created by the success of the trips executed by her before and after the mishap. Her unintentional voyage was a fine adventure, and its safe outcome reflected a great deal of credit on Lieutenant Booth and his crew. But the public will never learn to put its faith in airships so long as such happenings occur or are at all likely to occur.

Of the experiments conducted with the R 33 little official information is available. It is known that valuable data have been obtained during her flights on the stresses thrown on her structure, and that subsequent to her mishap experiments, understood to have been successful on the second essay, were carried out on the release and re-attachment of an aeroplane while the airship was in mid air.

Helicopters.

The Brennan helicopter, begun at the Government's expense at Farnborough towards the end of the war, continued to receive attention during the year, and progress with it was made so far that on October 2nd it was taken out of its shed, where it had been jealously guarded against prying eyes, and tested in the open air. Its trial did not, however, last long. It had risen only a foot or two off the ground when it appeared to lose its stability, presumably as the result of the action of forces external to itself, and crashed, doing some damage to its structure. It was understood that the damage done would be repaired, but since the date of the mishap nothing further has been heard of the machine. Meanwhile another type of machine, not strictly speaking a helicopter, although far removed from the conventional design of aeroplane, had made its appearance in this country in the form of the Cierva "Autogiro." This machine, a Spanish invention, consists of an aeroplane body with the wings removed, and carrying on the top of its fuselage a large four-winged windmill. The windmill, with its wings mounted to rotate in a more or less horizontal plane, is not driven directly by an engine but revolves under the influence of the forward motion of the machine, which motion is derived from an engine and tractor screw mounted in the usual way at the front end of the fuselage. On October 19th Mr. F. T. Courtney publicly demonstrated the capabilities of the machine at Farnborough. The results achieved were certainly impressive. In full flight the machine achieved a forward speed stated to have been 68 miles an hour, while from a height of 500ft. it descended practically vertically to the ground, its forward speed at the moment of alighting being not more than 10 miles an hour. The machine at a subsequent test met with a slight mishap, but the principle on which it works is now, it is understood, being made the subject of a close study by the Air Ministry authorities. Illustrations of the "Autogiro" on the ground and in flight were given in our issue of October 23rd.

Water Supply in 1925.

The Queen Mary Reservoir.

THE most important event of the year in water supply engineering in this country, if not in the world, was the opening by the King, in June, of the Queen Mary Reservoir at Littleton, of the Metropolitan Water Board—see Supplement. The importance of the undertaking lies not so much in the fact that any special engineering difficulties had to be overcome—though, as a matter of fact, numerous difficulties were encountered and successfully surmounted—as in its vast size. It is the largest entirely artificial reservoir of its kind which has been constructed anywhere, and it will contain, when it is full, no less than 6750 million gallons of water. It owes nothing to mountain sides, for it is built on a very nearly level site, and it is contained within an earth embankment, having a central clay puddle wall, which is about 4 miles round. The water surface at top water level will be 723 acres, which is but little less than that of Thirlmere and almost exactly the same as that of Hawes Water from which Manchester is about to obtain an additional supply of water. The water in it would fill a canal stretching between London and Glasgow 50ft. wide and more than 10ft. deep, and it would be enough to supply the needs of "Water London" for nearly a month without assistance from any outside source of supply. The work of constructing the aqueduct to lead the water from this reservoir to the Hampton and others of the Board's pumping and filtration works was in progress during the whole year, and is now, we gather, very nearly completed. As we hope to describe the latter undertaking at some length in a forthcoming issue, we need only say here that it runs to about 6820 yards in length, that it varies in diameter from 8ft. to 4ft., and that part of it is of reinforced concrete built in trenches and part of it of cast iron pipes, mostly in trenches, but, as to some 850 yards, in tunnel.

Manchester Corporation Waterworks.

Thirlmere.—The works for the diversion into Thirlmere of the drainage of about 2400 acres, forming the north-easterly part of the catchment area, which were started in October, 1923, made good progress. These works, which are being carried out by administration, consist of a short length of tunnel, and about 2 miles of open watercourses, with catchwaters, &c. About five-eighths of the total length of the watercourses had been completed at the end of November. The laying of a fourth pipe line from Thirlmere, which was commenced in June, 1922, was completed to within 15 miles of the city. It is not intended to lay the remaining length for the present, but to increase the carrying capacity of the existing pipe lines by means of an electrically driven booster plant, which is now being installed, and will be ready for bringing into commission early in this year. About 1¼ miles north of the booster plant, straining chambers have been constructed, and through them all the water brought from Thirlmere will pass before it is turned into the trunk and distributing mains.

Heaton Park Reservoir.—The construction of a service reservoir of 550 million gallons capacity at Heaton Park, about 4¾ miles north-east of the city, was continued. During the year an area of about 11 acres was excavated to formation level, and about 35,000 cubic yards of the excavated materials taken for banking or spoil. About 74,000 cubic yards of clay puddle lining were put in, about 13 acres of beaching were laid in the reservoir bottom, and about 3 acres of squared pitching completed on the banks and slopes.

The Haweswater Scheme.—On the Haweswater scheme resident engineers have been appointed, and they are now engaged in the preliminary survey.

Bradford.

The very considerable works which the Waterworks Department of the City of Bradford has in hand made good progress during the year. In the Scar House Reservoir works, favourable weather admitted of concreting being carried on until the end of December, 1924, after which, for about four months, concerted efforts were directed to the completion of the tongue and wing trench excavation, together with the roughing and preparation of the foundation for concrete. By the beginning of June the tongue trench portion of the foundation had been completed over an area of sufficient length to permit of concreting being begun, and the work was initiated by Lieut.-Col. A. Gadie, the chairman of the Water Committee, who deposited the first batch of concrete on June 5th. The two extreme ends of the 6ft. wing trenches were bottomed-up early in August. The depth of the tongue trench at the river bed is about 60ft., and the north and south wing trenches reach a maximum depth at 260ft. and 267ft. respectively, the strata met with consisting for the most part of sandstone, shale and limestone. Work in those trenches was carried on under exceedingly disagreeable conditions; slight trickles of surface water and innumerable microscopic but water-bearing cracks in the higher strata cumulatively resulted in what is described as a perpetual shower bath, which necessitated the workmen being clad in oilskins. The restricted width of 6ft. did not admit of chutes or other devices being used for collecting the water at intermediate levels, and at the same time prevented the penetration of daylight, so that artificial lighting had to be introduced at an early stage of the work. In spite of these various difficulties, however, the total volume of concrete and displacers—inclusive of the concrete piers which carry the crane and the railway stagings, and which will ultimately be incorporated in the dam—amounted to approximately 81,500 cubic yards by the end of October.

A complete little town, known as Scar Village, has been built near the works, and it has a total resident population of over 1100. It stands at 1000ft. or so above sea level, and the inhabitants are housed in neat bungalows and hostels, and are provided with a church, a lending library, a concert hall, a school, a savings bank, a canteen, a hospital, &c.

The Water Department is also erecting a mechanical filter house at Thornton to remove the peat stain and the plumbo-solvency from the water drawn from

the Stubden Reservoir, which is derived from a moor and peaty gathering ground. It has also recently begun the covering-in of the service reservoirs at Idle Hill, Gilstead and Thornton Moor, and has in hand the construction of some new extensive filtration works at Chellow Heights.

Taf Fechan Water Supply Board.

The Taf Fechan reservoir embankment—which will be 110ft. high, 1000ft. long, and create a reservoir with a capacity of over 3000 million gallons—and incidental works, are now rapidly approaching completion, and it is anticipated that impounding may commence about next April. In April last a contract was let to the Paterson Engineering Company for the construction of filters of 7·5 million gallons a day capacity, and a filter house, and that work is due for completion about August next. A contract was let to Piggott and Co., Ltd., in January last for the supply of welded steel pipes lined with mortar, and varying in diameter from 37in. to 17in., and for smaller mains in cast iron, the whole totalling some 20 miles, and that work is well advanced. The pipe laying contract was let to C. V. Buchan and Co., Ltd., in January last, and some 8 miles, chiefly of the larger diameters, have been laid to date.

Loch Katrine Works.

The various works in connection with the raising of the level of Loch Katrine, of which we have made mention in several previous Annual Articles, proceeded satisfactorily during the year. The raising of the dam at the outlet was practically completed. The by-wash will be finished temporarily to a height 2ft. 9in. below the statutory top water level, and will be raised next autumn to the full height. The work of raising the level of the basins at the entry to the aqueduct tunnels was completed. The steamer landing stage—a floating pontoon between concrete piers—at Stronachlachar was finished and was in use all the summer season, together with the new approach roads, marshalling ground for coaches, and other accessories. The last instalment of the construction of the public road along the north shore is progressing very rapidly and will be finished early in the present year. It is intended to continue this road as a footpath right round the head of the loch. There still remains a piece of work to be contracted for, namely, the raising by 5ft. of the top of a stretch of pitching which extends for nearly a mile along part of the north shore, protecting a very friable bank, to which at some points the public road approaches very closely. It is hoped that, with moderately good weather next summer, the whole of the works involved in this undertaking will be completed or in such a condition that the rainfall of the autumn and winter may be stored to the full authorised capacity for use in and after the year 1927. The effect of raising the level of the loch by 5ft. will be to alter the total available storage capacity in the loch from about 10,000 millions of gallons to 14,000 millions of gallons.

Cardiff.

The construction by administration of the Llwynon reservoir embankment and overflow weir, by-wash and subsidiary works was completed. During the summer the stop piece was built in the discharge culvert, and the erection of the valves and ironwork in the valve shaft is now nearing completion. The valve house and the road diversion over the embankment still remain to be completed, together with the fencing and clearing up of the site of the works. It is hoped to open the reservoir during next summer. The roughing filter buildings are now roofed in. The work remaining to be done is the completion of the engine house, the erection of machinery and the installation of the hydro-electric plant, together with the lighting and heating of the engine house. The first 14 miles of the Taff Fawr section of the second pipe line was completed and tested throughout. This section is composed of 27in. diameter main with a discharging capacity of about 20 million gallons a day. The lower or "B" section, 15 miles in length, has just been commenced. This work includes the construction of an elevated break pressure tank, foremen's houses, three pipe bridges, three subways, and an intake gauging chamber at the point of discharge. The main will consist of 11 miles of 30in. diameter and 4 miles of 24in diameter pipes. Automatic valves and other subsidiary works are being introduced at various points on the line The pipes are of lap-welded steel, concrete lined. Considerable progress was made with the construction of the Wenallt reservoir, which will be of a capacity of 15 million gallons. The concrete foundations to the walls were carried to various depths, with a maximum of 18ft. They are now completed and the brick-faced concrete walls are being built thereon, and have attained an average height of one-third of the total height of 23ft.

Wakefield's Ryburn Valley Scheme.

Having obtained permission in its Act of 1924 to carry out its Ryburn Valley water scheme, the Wakefield Corporation proceeded with preliminary works during last year. The scheme, the estimated cost of which is £930,000, consists in the formation of what are known as the Ryburn and Baitings reservoirs, by means of dams 95ft. and 132ft. high respectively, the laying of a trunk main 23 miles in length of cast iron and steel pipes 22in. and 20in. in diameter, the driving of a tunnel half a mile long at Barkisland, the construction of a filtration plant, with a capacity of 2¾ million gallons per day at Kirkhamgate, together with catchment water and other ancillary works. During the past year the construction of the intake works in the Ryburn Valley, which are to be carried out by direct labour, were begun, and the survey of the pipe line was completed. The laying of the pipe line will be somewhat difficult as it will pass down the industrialised Calder Valley. The first 3 miles of it are to be laid by direct labour.

Belfast's Silent Valley Scheme.

Work in connection with the construction of the extensive new storage reservoir in "Silent Valley," in the Mourne Mountains, for supplying additional water to Belfast, made good progress during the year. The works railway, which is about 6 miles in length, and extends from the seaport town of Annalong to the site of the new reservoir, and also about 5 miles of branch railways, at different elevations, in the Mountain Valley, to connect with all parts of the main works and the granite quarries at the site, were completed and were in regular use, from the early months of the year. The sinking of the valve shaft and the driving of the main outlet tunnel for over 500 lineal yards in the granite rock, also the branch draw-off tunnels, were opened out to the full size, and most of the main tunnel has already been lined with concrete, while the inner brick lining, to the net size of 13ft. by 12ft., is now in hand, and at the end of the year was completed over about half the total length of the tunnel. The river diversion channel, on the upper or reservoir side of the main outlet tunnel, was excavated and the bottom and side slopes were almost completed and lined with granite pitching. The outlet channel, extending from the lower or tailbay end of the outlet tunnel, into the Kilkeel River, below the reservoir, is also well forward, having about four-fifths of the total length completed with concrete floors covered with heavy granite pitching, and the heavy side walls of concrete faced with granite rubble work. The excavations and concrete work are well forward, for the formation of the extensive underground screening and Venturi meter chambers, adjoining the tailbay and outlet channel, as well as the formation of the necessary approach roads to this section of the main works.

The west and east lengths, at the higher levels of the main concrete trench, along the centre line of the main embankment, have already been excavated to varying depths into the solid granite, but the middle length of the main trench, immediately adjoining the Kilkeel River, has not yet been opened up, and will not be until after the waters of the main river have been permanently diverted and controlled through the main outlet tunnel. The seat or base of the main embankment has been cleared of the soil and soft materials, and special stone drains have been formed in the outer half, and some of the general filling layers have also been put in to form the lower portions of the main bank, adjoining the rubble stone toes, at the inner and outer portions of the embankment.

A new high-level roadway is partially formed over about 1¼ mile of its length, along the east mountain slope, above top bank level of the reservoir, and a branch railway was formed and to work on this road for the haulage of materials to and from the high-level portions of the permanent works on that side of the valley. All the temporary villas for the housing and accommodation of the supervising engineers, clerical staff, also the foremen and workmen's huts-ments, were completed and are in use at the site of the works; also a cinema an recreation buildings, while a well-equipped hospital building, with visiting and resident medical and nursing staff is now available for the immediate treatment of all cases of accident and sickness occurring among the residents employed at the works. There are also the main office and administration buildings, and extensive electric power station, engine works, mechanics' shops, cement and general store buildings, as well as saw mills, locomotive repair shops, and other similar works buildings erected and in use at the site of the works. There is a daily train service between the town of Annalong and the works at Silent Valley, and all workmen living at a distance are conveyed to and from the works in comfortable works trains, night and morning. An average of about 700 workmen of all kinds were constantly employed during the past year.

Works in Hand or in Contemplation.

Among the many schemes at present in hand or in contemplation may be mentioned the following:—Sheffield is extending its mains and installing pressure filters at a cost, it is said, of some £160,000. Carlisle has a proposal to bring additional supplies from the Cumberland hills, the sum involved being reputed to be nearly £70,000. The inlet heading of the Aber tunnel, which Liverpool is constructing with a view to increasing the volume of water which can be drawn from Lake Vyrnwy was advanced 900ft. during the year. Important new works are being carried out by the Fylde Water Board, at a cost of £230,000. The estimated cost of a new water scheme for the Forest of Dean is £50,000. Bolton has applied for powers to borrow upwards of £70,000 for new constructional works. Scarborough is considering the carrying out of new works at a cost of £80,000. Pontefract is expending £75,000 on well sinking and other works at Eggborough. The Bathgate District Committee received sanction to borrow £362,000 for new works. The first shot was fired for the construction of a new reservoir, &c., for Batley, the expenditure on which is to be some £500,000. Hastings has in hand a scheme to obtain additional supplies from wells in the neighbourhood of the Cuckmere and Ouse valleys, at a cost of some £500,000. Pontypridd and Rhondda are to spend £430,800 on new works. Bilston is considering a scheme to cost over £70,000, and Londonderry a scheme estimated to cost £110,000. Bacup put to work new mechanical filter plants at Cowpe and Sheephouse. Melton Mowbray completed a new 1,000,000-gallon reservoir. The first sods for some extensions to its supplies were cut by Rugby in November. The Wemyss Water Trust is to spend £121,000 on reservoir extension. Dublin has applied for powers to spend £120,000 on extensions to mains, and Birmingham is building a new reservoir at the end of its Elan Valley aqueduct and extending its third pipe line from that source. In addition to the foregoing, works of greater or less importance are being carried out or considered by Plymouth, Nottingham, Newquay, Bolton, Goole, Stafford, Chichester, Northwich, Ramsgate, Lancaster, the Doncaster and Tickhill Joint Water Board, Cork, the North Cornwall Water Board, Blyth, the East Westmoreland Rural District Council, Keighley, Paignton, Torquay, Barnsley, and many other places. Apparently the Loch Ordie scheme for giving an additional supply of water to Perth, which has been in contemplation for so long, has now been finally abandoned, or, at any rate, postponed indefinitely. The works which, as we mentioned in our last annual Article, were being carried out by the Tees Valley Water Board, were completed. Good progress was made with the 8,000,000-gallon covered reservoir, which is being constructed by the Colne Valley Water Company, and it, and the various mains being laid in connection with it, will be brought into service during the present year. Aberdeen will have completed the whole of the new works, which it has in hand, early in this year, with the exception of the Airy Hall service reservoir, which will not be finished till the autumn.

The Sennar Dam and the Gezira Irrigation Scheme.

A large amount of irrigation work is being carried out in all parts of the world: in America, in Africa, in India, in Australia, &c. It would be impossible for us, with the limited space at our disposal, to give a list of even the more important of the various projects, but the most noteworthy undertaking to be completed during the year was the construction of the Sennar Dam—see Supplement—by means of which 300,000 acres in the Gezira District will be irrigated. Concurrently with the building of the dam an extensive network of main and subsidiary canals and field channels was being formed, and all was, we understand, ready for service when the water held up by the new dam had in July reached a sufficiently high level to feed the canals. We have so recently—see THE ENGINEER, July 3rd and August 28th—described both the completion of the dam and the irrigation scheme itself, that we need not go into any great detail in the present instance, and need only say that an illustration of the head regulator in the main canal is given in our Supplement. The work completed during the past year only forms a first, and comparatively small, portion of a far bigger undertaking which will be entered upon should the present venture prove to be a success, as, indeed, there is very good reason for believing it will. The area which it is proposed finally to irrigate amounts to no less than 3,000,000 feddans, or 3,120,000 acres. The Gezira is looked upon as being one of the finest districts in the world for cotton growing, and it is confidently anticipated that 30 million lb. of cotton will be produced per annum when the whole area is cultivated. As giving some idea of the size of the present portion of the undertaking, we may say that the distance from the head of the main canal to the northern limit of the scheme, as at present contemplated, is 150 kiloms., and that from kilom. 57, where irrigation commences, the area being developed has a width of 25 kiloms.

Hong Kong Water Supply.

The first section of Hong Kong's Shing Mun Valley Scheme, in the New Territory, was begun early in the year, and work on the following is now in progress:—(*a*) An access road two miles long; (*b*) a temporary dam stream intake; (*c*) a temporary conduit a mile and a-half long; (*d*) two tunnels over a mile long and a concrete connecting aqueduct; (*e*) a reception reservoir to hold 50 million gallons; (*f*) rapid gravity filters to deal with 5 million gallons per day; (*g*) a 24in. diameter steel pipe line 5 miles long; (*h*) two reinforced concrete service reservoirs, one of 5 million gallons, and the other of a quarter of a million gallons capacity. To connect the new supply with the existing system in Victoria, Hong Kong, it

will be necessary to convey the water across the Harbour, a distance of about 1¼ miles, with a depth of water varying up to 60ft. It is proposed to employ two lines of 18in. pipes laid in a trench dredged from shore to shore, with special works on each side of the Harbour where connection will be made with the land mains.

Singapore Water Supply from Johore.

During the year a contract was let and completed for the supply by Stewarts and Lloyds, Ltd., of the 39in., 36in. and 33in. diameter welded steel pipes required for that portion of the pipe line between the headworks and the Strait of Johore, a distance of 17 miles. Pipe-laying contracts for that length were also let to local firms of contractors and laying is now in progress. The pipes, like those used on the island of Singapore, are being lined with mortar and served with hessian; that work is being carried out at a depôt on the mainland near Johore Bahru. The island pipe laying is now about half completed. The headworks on the Pulai River are being carried out by direct administration. The excavation for the dam foundations is nearing completion, and it is anticipated that the masonry work will be commenced at an early date. Owing to an unexpected influx of Chinese which followed the troubles in China, it has become necessary to consider the putting in hand of the works required to bring in the second instalment of the undertaking several years earlier than was anticipated, and one of the partners of Sir Alex. Binnie, Son and Deacon, the consulting engineers for the scheme, is about to visit Singapore in order to report fully on the matter.

Other Works Abroad.

To attempt to give even a list of the many works which are being carried out in other parts of the world would be impossible. Mention of a few may, however, be made. Among the most interesting are the extensions being carried out by Vancouver, B.C. A steel pipe line, some 13 miles long, is being laid from the intake on Seymour Creek to a reservoir on Little Mountain. The line will cross the Burrard Inlet at the Second Narrows, where it will be submerged. A tunnel, some 700ft. long, is to be driven in order to tap the waters of Burwell Lake at a depth of about 120ft. Reval has decided to construct new works to obtain some 5½ million gallons per day from the Upper Lake, to construct a service reservoir of some 1¾ million gallons capacity, and to install mechanical filtration and pumping plant at a total cost of some £90,000. Sydney, N.S.W., has under consideration a scheme for obtaining an additional 47 million gallons per day by constructing a dam at the junction of the Wentworth or Barton's Creek, with the Grose, the estimated cost being upwards of £2,500,000. Toronto, the present supply of which is some 82,000,000 gallons per day, is proposing to spend some £2,400,000 on the construction of new works near the eastern limits of the city, and on the duplication of its present intake and filtration plant. Madras is raising the level of Red Hills Lake by 18in., thus increasing the capacity of the reservoir from 2162 to 2440 cubic feet. The pipe line from Khor Arbast to Port Sudan, which is 6in. and 8in. in diameter and crosses 18 miles of desert, was completed. Bombay has decided to chlorinate the whole of the Lake Tansa supply, amounting to 110,000,000 gallons per day. Capetown is laying over 33 miles of 32in. internal diameter concrete lined steel pipes from Steenbras. Some of the line will be under a pressure due to 1400ft. of water. The Cuban Government is laying a number of new mains in the island. The Republic of Salvador is also engaged in extensive main-laying operations. The construction of the Shongweni dam, which is to impound 2600 million gallons of water for the additional supply of Durban and which will, with its accessory works, cost some £750,000, proceeded satisfactorily, and will probably be completed next August. The Maroondah dam, which is being constructed in the valley of Watt's River for providing an additional supply to Melbourne, will impound 4855 million gallons of water. It is of concrete and will be 135ft. high and 946ft. long. A note concerning the water supply of Paris appeared in our last issue. During the year the laying of the mains and the erection of the pumping stations, by means of which additional supplies are to be delivered to the city from the Voulzie, Durteint and Dragon, made good progress, and very little remains to be done to them. The filtering arrangements at Ivry were also considerably increased in capacity during the year.

For some time past boring operations have been in progress at the Matts Yard Pit, Newhall, near Burton-on-Trent. It is understood that a search is being made for the Silkstone seam, which is suspected to underlie the already proved seams. Boring operations are also in progress at Newhall, South Derbyshire, for the purpose of locating the Silkstone seam. This coal has not hitherto been found in South Derbyshire, but it is thought likely that it will be struck underlying already proved seams, although probably at considerable depth. The boring is being carried out at the Rats Yard Pit of Nadin and Co., Ltd., but other concerns in the district are interested in the search.

The Physical and Optical Societies' Exhibition.

THE sixteenth annual Exhibition of electrical, optical and other physical apparatus, held under the auspices of the Physical Society of London and Optical Society, was opened at the Imperial College of Science on Tuesday last, and closed on Thursday, January 7th. As usual, the Exhibition was of considerable interest to scientific people, and to some extent to the general public. Although there were a good many things that were not new and which had been shown before, there was as usual a very fair display of original apparatus.

RESEARCH EXHIBITS.

A notable feature of the Exhibition was that the research departments of several of the large electrical firms were represented. Quite a number of interesting things were shown by the research laboratories of the General Electric Company and Henley's research laboratories. Captain P. Dunsheath, who is at the head of the latter firm's research department, has found that the use of solid diagrams or models to illustrate the variation of loss and power factor in a cable dielectric with temperature, voltage and frequency, is very helpful in cable research work, and at the Exhibition a number of these models were shown. The comparison of blocks constructed from the results obtained on several cables shows up the relative merits of cables much more readily than the comparison of the figures themselves, and, in addition to providing a method of interpreting the results, the system also facilitates speculations as to what goes on outside the actual range of the test results available.

The National Physical Laboratory showed, among other things, an "all-metal" mercury vapour pump and apparatus for studying the general directions in which sound waves are reflected on reaching the boundaries of auditoriums. Use is made of the analogy between sound waves and water waves. A model outline of each section of the proposed building is laid on the glass bottom of a shallow tank of water. Waves generated within the section proceed outwards in circles and are then reflected from the boundaries. Observation is made to ascertain which features of the shape need modification to suppress undesirable echoes. Another of the National Physical Laboratory's exhibits was a fog hygrometer, an instrument which has proved of value for humidity measurements in cold stores. It is based on the principle of fog formation in an atmosphere when adiabatically expanded. A charge of air in a well-illuminated chamber is suddenly expanded into a reservoir, the pressure in which is adjusted until on successive trials a fog is just visible or just not visible. The limiting value of the pressure is a simple function of the humidity.

The exhibits of the General Electric Company's research laboratories consisted, among other things, of apparatus for comparative determinations of the coefficient of glass. The glass rod to be tested is in the form of a rod, and it is placed parallel to another rod of glass of known expansion, the two being sealed together at one end. A small steel roller of known diameter is inserted between the free ends of the rods, which are flattened. The two rods are inserted in an electric tube furnace and are heated to a known temperature, the only part exposed being the ends carrying the roller. A small mirror attached to the roller allows the amount of rotation of the latter to be measured, and the relative expansion of the glasses can then be calculated. Another of the General Electric Company's exhibits was a reduction gear for experimental purposes. This gear has a very wide range of speeds, and is particularly useful for experiments in which the speed reduction required is not known within wide limits, or where it is desired to have widely varying speeds available. There are six gears and three belt pulleys, so that eighteen speeds are available, the ratio between any gear and the next being $1 : \sqrt[6]{2}$ or $1 : 1{\cdot}260$, the total range being about 50 : 1. Reversal is effected by crossing the belt, the motor being mounted on runners for this purpose.

There was also a tensile testing machine for fine wires. The strain is applied uniformly at one end of the wire by a motor, through a reduction gear, the elongation being measured by the movement of the gear. An audible signal is given at every—prearranged—increment of length. The load is measured by the deflection of a cantilever. This is magnified by projecting a scale attached to one end of the cantilever. A correction can be inserted in the stress-strain diagram for the movement of the end of the wire attached to the cantilever. A miniature vacuum furnace exhibited consists of a small tungsten tube, about 2 mm. diameter, closed at one end, and made of tungsten strip, bound with tungsten wire, which is welded at the ends on to copper electrodes, and heated by the passage of a current. The housing consists of a glass bulb cemented with vacuum wax on to a water-cooled base, into which is fixed the vacuum pump connection. For the purpose of inserting or removing resistance from a circuit at constant rate, a resistance with a uniform movement was shown. The slider of the rheostat is moved at a uniform rate by means of a falling weight, controlled by an oil dashpot, and the rate of movement is adjusted by altering the oil leak.

One of the principal exhibits of the Cambridge Instrument Company, Ltd., was a combined accelerometer and air speed recorder for aeroplanes—as shown in Fig. 1. For many purposes, as, for example, in aerodynamic research, it is desirable to obtain permanent records of the speeds attained during a flight, and also to record simultaneously the acceleration normal to the direction in which the aeroplane moves, and the instrument shown in Fig. 1 has been

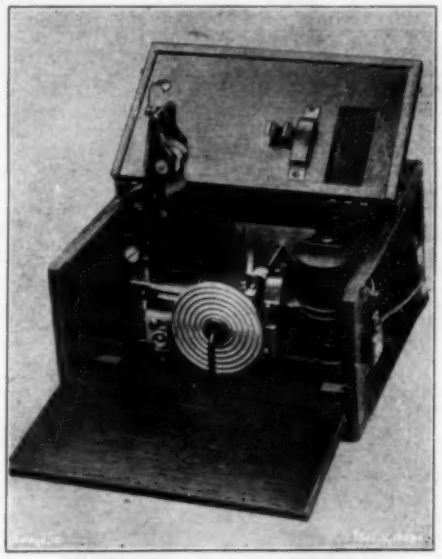


FIG. 1—COMBINED ACCELEROMETER AND AIR SPEED RECORDER

designed for this purpose. It comprises a Cambridge recording accelerometer as used for measuring accelerations in road and railway vehicles, &c., mounted, together with an air speed recorder, within a closed case. The essential feature of the instrument is the method, due to Mr. W. G. Collins, of recording on transparent celluloid film the movements of a stylus. The accelerometer may be used for recording the component of the acceleration in any direction in respect of the aeroplane. A plan of the essential parts of the accelerometer, as placed for recording vertical accelerations, is shown diagrammatically in Fig. 2. The mass M is supported by two flat steel strips B and B_1, and is connected by means of an additional steel strip N to a member O moving on knife edges K and K_1. This member carries a flat strip of aluminium A, the extremity of which is free to move between the poles of an electromagnet E. Fixed to the aluminium strip A is the stylus S. Any movement therefore of the mass moves the stylus across the celluloid film F, which is caused to pass round the roller R by means of clockwork mechanism. The speed of travel of the film may be varied from 3 mm. to 20 mm. per second. The eddy currents

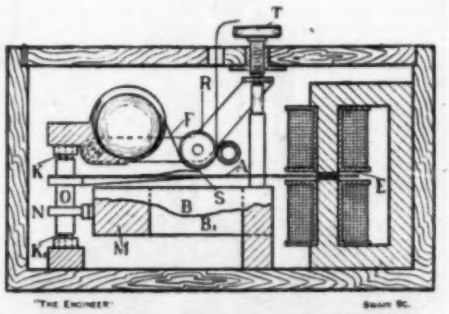


FIG. 2—ARRANGEMENT OF ACCELEROMETER

set up by the movement of the aluminium strip between the poles of the electromagnet render the instrument almost critically damped. The natural period of the whole system is approximately 0·025 second. With this period the sensitivity is approximately 1 mm. on the actual record for an acceleration equal to *g*, *i.e.*, 32ft. per second per second. This represents a considerable distance on the record which, when suitably magnified, can be read to 0·01 mm. Other sensitivities can be quickly obtained by altering the control springs, with corresponding changes in the period. The pressure of the stylus on the film can be varied by means of the screw T. A time datum line is marked on the film by a second stylus operated by an electromagnet, which is controlled by means of a clock making contact every tenth of a second or by other mechanism designed to give regular time signals.

The air speed is measured by a Pitot tube of the standard aircraft pattern, mounted in a position clear of slipstream and wing disturbance. The

dynamic tube is connected to the interior of a differential manometer of the aneroid box type, mounted within the case of the recorder, while the static tube is simply connected to the inside of the case, which is rendered as airtight as possible by means of rubber packing. Movements of the manometer due to the fluctuating differences between the static and dynamic pressure caused by variations in the air speed are communicated to a recording stylus, which makes a record upon the same celluloid strip as the acceleration and time styles. The instrument can be adjusted for any practicable range of speed, and if carefully calibrated with its Pitot tube, has an accuracy of at least 0·5 per cent. at the maximum speed. The

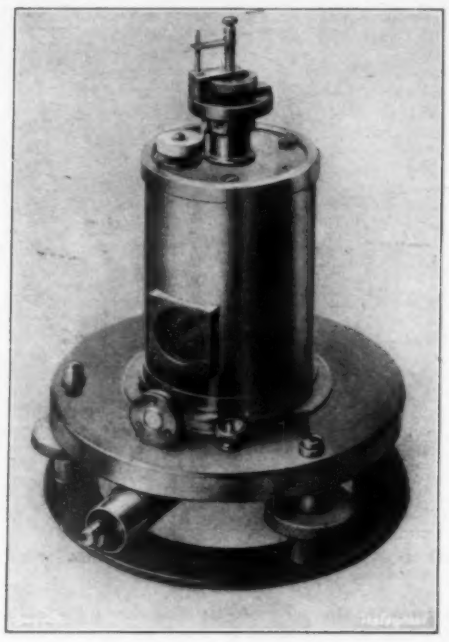


FIG. 3—CROMPTON ELECTROMETER

records are immediately available for examination and measurement, and they are claimed to be permanent, accurate and capable of withstanding the worst conditions of dirt and wet without special precautions. The lines forming a diagram are clearly defined, and will bear considerable magnification. They can be examined at once by means of a microscope, or direct enlargements from the actual diagrams can be obtained by photographic methods by a camera lucida or by projection upon a screen and tracing. The dimensions of the instrument are 9in. by 6¼in. by 8¼in. and the weight 13 lb.

The Compton electrometer—shown in Figs. 3 and 4

FIG. 4—CROMPTON ELECTROMETER, CASE REMOVED

—was another of the Cambridge Instrument Company's exhibits. The design of this instrument is primarily due to Professors A. H. and K. T. Compton. It is of the quadrant form, and is suitable for the quick and accurate measurement of small electric charges or small potential differences. It possesses a high sensitivity which is practically independent of the angle through which the needle deflects. The moving parts come quickly to rest when measurements are being made. Electrostatic control is obtained by slightly tilting the needle about its long axis, and at the same time moving one of the quadrants a little above or below the plane of the other quadrants. This type of control possesses the important advantage of giving nearly constant sensitivity over a large range of deflections, and of permitting quick adjustment to any desired amount of control, either positive or negative. The sensitivity can be varied over a wide range by varying the height of the needle or of the quadrant, or the angle between the needle and the quadrants. The geometric design of these adjustments eliminates backlash. When once the instrument has been set up, it can immediately be brought to any required sensitivity, as the different movements can be accurately repeated from time to time. The fundamental minimum sensitivity at, say, 45 volts, is approximately 3000 mm. per volt per metre. This can easily be increased to 15,000 mm. per volt, while by careful adjustment considerably higher sensitivities have been obtained.

A vacuum thermo-element was exhibited by the Cambridge Instrument Company, Ltd. If a thermo-pile is placed within a vacuum, its sensitivity is considerably increased, while disturbances due to air currents are eliminated. Thermo-piles constructed in this way, however, have not hitherto yielded the results which might have been expected, owing to the great heat capacity of the thermo-elements. By making use of extremely thin strips of metal for the thermo-element, Drs. Moll and Berger have succeeded in constructing a vacuum thermo-element having a sensitivity about 100 per cent. higher than in air. It comprises a thermo-pile A B C—see Fig. 5—made

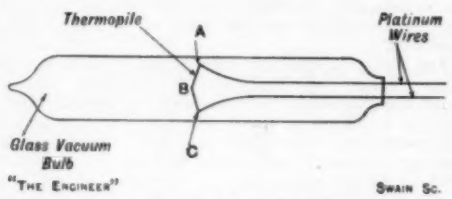


FIG. 5—MOLL AND BERGER VACUUM THERMO-ELEMENT

of constantan and manganin strip brazed together at B and blackened on one side. The strip is less than 0·001 mm. in thickness even at the junction of the two elements. The thermo-pile is mounted on platinum wires fused into a glass envelope, which is exhausted to a high degree of vacuity. In order to protect the thermo-pile against unequal heating, the glass is enclosed in a metal case, having double walls insulated from each other. Windows are provided on opposite sides of the case, in front of and behind the thermo-pile. The front window is fitted with a glass plate, which can be replaced, if desired, by a microscope slide cover glass or a microscope objective. The window at the rear of the thermo-pile is fitted with a lens, so that the position of the thermo-pile may be adjusted relatively to the other parts of the apparatus. Copper terminals are fitted to the platinum wires. The thermo-element is particularly suitable for spectrum work. It is said to be extremely rapid in action, the position of equilibrium being obtained within three seconds of the time of throwing the radiation on to the thermo-pile.

WIRELESS EXHIBITS.

There were some very fine wireless exhibits, including the Igranic Electric Company's supersonic heterodyne receiver, suitable for use with a frame or open aerial. For the construction of these sets all the necessary units and accessories are supplied by the Igranic Company. Special oscillator and intermediate frequency coupling units have been evolved. After comparative tests with various methods of coupling for the intermediate frequency amplifier, a novel form of reactance capacity coupling was developed, and it is claimed to make the set extremely stable and to give clear reproduction. Potentiometer control has been found to be unnecessary, and the method that has been adopted for stabilising the units is said to result in a very high degree of amplification. Another feature to which the makers direct attention is that it is not only possible to obtain highly efficient reception within the broadcast band of wave lengths, but stations operating on wave lengths up to more than 4000 m. can also be received.

Marconi's Wireless Telegraph Company was exhibited an exceptionally good collection of wireless apparatus, including a short wave receiver—as illustrated in Fig. 6. This receiver, which has a wave range of from 15 m. to 100 m., is a reproduction of the experimental apparatus used in different parts of the world by Senatore Marconi's yacht the Elettra, for the interception of short wave signals from the Poldhu station. Two valves are used, a detector and a low-frequency amplifier, the apparatus being designed to employ Marconi D.E. 5 valves. An aerial, either of the "T" or "L" type, 50ft. to 150ft. long, is suitable, but it is essential that it should be out of tune with the incoming wave, both as to fundamental and harmonics, and its tuning must always be over the wave length to be received. Two sets of tuning coils are supplied, together with a calibration chart for each receiver. The respective range of the coils is (1) 15 m. to 40 m., and (2) 35 m. to 100 m. Three 40-volt dry batteries supply the high tension for the

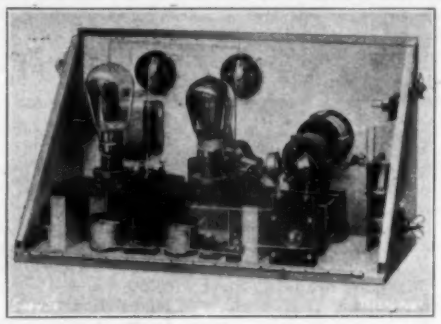


FIG. 6—MARCONI SHORT WAVE RECEIVER

receiver, the detector taking 80 volts, and the low-frequency amplifier 120 volts.

Among other exhibits on the Marconi Company's stand was an eight-valve receiver without reaction. It is composed of five high-frequency, one detector, and two low-frequency stages. Each of the high-frequency stages is tuned and separately controlled, adjustments for each being made by rotating the control dials to the wave length marked on the scales. The circuit, being technically known as "straight," has its valve capacities balanced out by a novel method. A volume switch is incorporated in the set. Six D.E. 3 and two D.E. 5 valves are used, making the total current consumption ·68 ampères at a pressure of 6 volts. Higher wave lengths than those of the broadcast band can be dealt with by the use of additional coils. The high-tension batteries are housed in the base of the instrument. The selectivity of this receiver is such that reception upon stations above or below the London wave length can be separated from each other within four miles of 2LO.

VARIOUS INSTRUMENTS.

Practically all the leading electrical instrument makers were represented, and some very excellent instruments were shown, but many of them were not new. Elliott Brothers exhibited Rayworth's differential cell-testing voltmeter, which has been specially designed for the complete testing of accumulator batteries. It is provided with a differential winding and cadmium electrode. The instrument can be used as an ordinary cell testing voltmeter, and, alternatively, will give the potential of each plate against the cadmium electrode, and will thus enable the condition of the plates of a faulty cell to be accurately ascertained. The instrument is also provided with special marks on the scale, and when used as a differential instrument—the positive terminal being connected to the positive plate and the negative terminal being connected to the negative plate, and the centre terminal being joined to the cadmium electrode—the reading of the instrument enables the state of charge of the accumulator to be definitely ascertained, the scale being marked with the fraction of the "charge" still available for use.

A very remarkable little instrument which will no doubt become very popular when its advantages and low price become more generally known was exhibited by Crompton and Co., Ltd. It is known as the "Alltest" multi-range portable moving coil instrument, and it can easily be carried in the pocket. It has a movement winding resistance of 5 ohms, and will give readings of 0–15 milli-ampères and 0/75 milli-volts, whilst by the use of a shunt attachment the range can be increased to 0/150 and 0/1500 milli-ampères. The normal multi-volt range is from 0/75, but by the use of resistance bobbin attachments the milli-volt range can be made 0–150 or 0–1500. Moreover, by the use of shunt attachments, the instrument can be made to read from 0–15 and 0–30 ampères. For ranges above 30 ampères any standardised shunt with a potential drop of 75 milli-volts may be used, provided that a suitable multiplying factor is employed.

The New Oscilloscope Company, Ltd., was exhibiting the Elverson oscilloscope, which is a scientific instrument for investigating the behaviour of machinery under actual working conditions. The instrument consists of a special lamp, which is arranged to give a momentary flash of great brilliance, and means for synchronising the flash of this lamp with the movements of the machine under observation in such a manner that the machine can be made to appear to be moving at one-hundredth of its actual speed, or apparently stationary at any point in its cycle of operations. It is therefore possible to observe any irregularities in the movements of the machine and to trace them to their causes or to analyse the complete cycle of operations. The method of operation of the oscilloscope was shown, both for quantitative investigations as well as cursory examinations of mechanisms in motion.

An interesting electric air flow meter was exhibited by Professor H. L. Callendar and Dr. H. Moss. The air flow is measured by the electrical energy necessary to give the air the same small fixed rise of tempera-

ture at all flows. The instrument is compensated to read correctly at all temperatures from — 50 deg. Cent. to + 30 deg. Cent., the energy being measured by a "volt-thermometer," which is independent of temperature changes and vibration effects. The instrument was designed for the measurement of the air consumption of internal combustion engines, where the air velocity is not constant, and may even reverse periodically. It has been applied to the measurement of the air consumption of an aeroplane engine when damping devices in conjunction with a simple instrument would not be employed.

On the stand of Cassella and Co., Ltd., there were many things of interest to engineers, but the most striking exhibit was the smallest. On a little block of steel there had been engraved a scale 1 mm. in length and divided into one-hundredths. Over each tenth the appropriate numeral was cut, and above it all the trade mark of the firm! Examined under the microscope, the beauty of this gnat-like work could be appreciated. Two instruments connected with mining may also be mentioned. One was a torsion wind gauge for measuring gentle currents of air in mines. It consists of a small metal plate, about the size of the palm of a lady's hand, hung from a horizontal wire, which can be twisted by appropriate mechanism. A tiny mirror attached to the plate reflects a spot of light on to a scale, and the spot is brought back to zero by twisting the wire. The other mining instrument, designed by Dr. J. S. Owens, is one for lowering into boreholes to register their varying dip and horizontal direction. It consists of a tube some 2ft. or more long, containing in the centre a dry battery and at the ends a clock, a small compass on gimbals and a clinometer. At intervals the clock closes a circuit and lights little lamps, which throw on to bromide paper records of the position of the compass and the clinometer. The apparatus is all enclosed in a metal sheath, some 2in. or so in diameter, and is lowered into the bore-hole by any convenient means.

Literature.

Geschichte des Eisens. By Dr. OTTO JOHANNSEN. Düsseldorf: Verlag Stahleisen M.B.H. 1925. Second Edition. Price 20 R. Marks.

ALTHOUGH it runs to 248 pages of quarto size, Dr. Johannsen speaks of this book as a short history, and that, no doubt, is a correct description, for the type is large and the illustrations take up a considerable amount of space; in any case, compared with Beck's five-volume work it is certainly a short history. It will be found also—perhaps, in part, as a result of this—a very interesting and readable book, whether by the man concerned in the iron trade or by the general reader. The student of the history of the manufacture of iron will probably wish for ampler treatment and documentation of many of the subjects touched upon; nevertheless, it is the best book now available covering the entire range of the iron industry. The fact that a second edition was called for within a few months of the issue of the first is some indication that it has been highly appreciated in the country of its origin.

After short sections on iron and ironmaking by the primitive races in Australia, America, Africa and Asia, and in the old civilisations of Egypt, Greece and Rome, we are led to the early Middle Ages in Western Europe, and then to the later Middle Ages. Here the subject is considered under a series of headings—the preparation of the fuel, the mining and preparation of the ore, blowing apparatus, smelting hearths and furnaces, hammer mills, the preparation and use of sheet iron and of wire, the blade smith, the needle smith, the blacksmith, smithing in the production of guns, and the merchanting of iron in the Middle Ages. Wire drawing by power, hammer mills and the invention of tin-plates are all ascribed to the fourteenth century. The production of iron plates under the hammer and the method of tinning are described.

Following the section on the later Middle Ages, we have one on the era of the charcoal blast-furnace. This is perhaps one of the most interesting in the book, dealing as it does with that supremely important event in the development of the iron manufacture—the substitution for the old process by which a mass of malleable iron was produced directly from the ore, of a process by which the iron was reduced to a fluid condition, the product being pig or cast iron. It is true that for the production of malleable iron the new process called for a further treatment, such as puddling, but, whereas the old method was necessarily intermittent and limited in output by the consideration of the removal from the furnace or hearth and the handling of the mass of iron, the blast-furnace worked continuously, fed with ore, fuel and flux at the top and delivering the fluid metal and slag at the bottom; it could remain in work so long as the material of the furnace itself held good. Moreover, there was no question of limiting its size on account of difficulty in handling the product.

The blast-furnace made its appearance at some time in the fourteenth century, and somewhere in the basin of the Rhine, possibly in the Lower Rhine Valley, although it is clear that it was known early on the Upper Rhine. Its use spread with some rapidity, and by the middle of the fifteenth century there were in Siegerland twenty-nine blast-furnaces and the old process had gone out of use. This rapid spread was due largely to the demand for cast iron guns and shot, but all the furnaces were not used for the production of castings, for the author states that one finds, quite early, blast-furnaces which made no castings—*i.e.*, the product of which was converted into malleable iron or steel. It would have been interesting if we had been given contemporary accounts of some of the early, conversion processes. Stress is laid upon the fact that the substitution of bellows worked by water wheels for those worked by men facilitated the production of the high temperatures necessary in the blast-furnace.

The advent of the blast-furnace, however, was not the occasion for the rise of the art of ironfounding. In the region referred to above it is clear that between the blomary or Catalan fire, with its shallow hearth, and the blast-furnace there came an intermediate form, the Stückofen, in the form of a short shaft. This was worked for the direct production of malleable iron, but its operation resulted, at any rate in the larger furnaces, in the production of a certain amount of fluid iron which was run off with the slag. Dr. Johannsen suggests that in some cases the Stückofen was worked for the production of fluid iron, although at the end of each blowing a bloom of malleable iron remained in the furnace. The fluid iron produced in the Stückofen had been remelted for the production of castings before the introduction of the blast-furnace. The art of bell-founding had long been established, and while in France and Italy forged iron guns remained in use till the fifteenth century, in Germany before 1350 guns were made of bronze. Bronze was costly, hence the desire to make use of iron, and it was the art of war for which iron castings were first employed. The earliest record that Dr. Johannsen gives us is unfortunately not dated; but there is no reason to doubt that it belongs to the end of the fourteenth century. In the archives of the city of Frankfort-on-the-Main is a letter from the gunner "Büchsenmeisher," Merckeln Gast, in which, after stating his qualifications in making and restoring the goodness of gunpowder, and that he can shoot with great and with small guns, he goes on to say that he can cast of iron small hand guns and other guns —"Item er kan clein handbussen und anderebussen uz jsen gyeszen." In 1415 there was at Freiburg, in Breisgau, an ironfounder who cast cannon balls in metal moulds. In the early days the practice was to melt down iron in small pieces in a bronze founder's furnace, but in the first half of the fifteenth century the practice of casting direct from the blast-furnace was introduced. In the second half of that century ironfounding was applied for purposes other than military, and first in Siegerland, which district seems to have taken the lead in developing ironfounding as an important branch of industry. There they cast pipes, bells, grids, weights and, in particular, ornamental stove plates and chimney backs. A chimney-back dated 1497 is illustrated, also the well-known chimney-back of Richard Lennard, of Brede, and a German example of the eighteenth century like it, depicting the process of ironmaking.

Dr. Johannsen states that potfounding was being successfully carried on about the year 1500, that in the sixteenth century ironfounders were using closed sand moulds, and that by that means were cast the corner pieces for cast iron stoves. On all these points one would have liked to have seen the evidence upon which the statements are based.

As to the introduction of the blast-furnace into England, the author makes the usual statement that it was due to Walloons and Germans. It is quite possible that Walloons and Germans did come over to erect and work furnaces, but there is no distinct evidence in support of that opinion; while, on the other hand, there is documentary evidence that a number of the founders and finers employed in the early Sussex works came from Picardy and Normandy. Very little seems to be known as to the spread of the blast-furnace in France, but it is likely that it was in use in Eastern France, at any rate as early as the second half of the fifteenth century.

The invention of the twin blast-furnace—two furnaces built in the same block—for enabling big guns to be cast from the small furnaces then in use, the author credits to Sweden, but it was in use in Sussex before the iron gun founding industry made any headway in that country.

Dr. Johannsen refers to Andrew Yarranton and his book, "England's Improvement by Sea and Land," and also to his visit to Saxony to investigate the method of making tin-plates; one would have liked an account of the manner of production of the round iron bars that Yarranton saw in Germany and so much admired. As the author says, the rolling of sheet iron begins with Hanbury and Payne in the early part of the eighteenth century, but it is claimed that the well-known Hans Lobinger used a rolling mill for iron in the sixteenth century; possibly this was something more in the nature of a bench or hand tool.

The second half of the book takes up the story from the time of the introduction of the coke blast-furnace, and here naturally England occupies the leading place. In the first section—the era of puddled iron—we have the invention of the steam engine, the improvement of the blowing apparatus, the invention of cast steel, the use of coke in the blast-furnace, the development of ironfounding in England, the invention of puddling, and the spread of the English technology into France, Germany and Belgium. The second section—the era of ingot iron—deals with coal and coke, blowing engines, furnace construction, stoves, furnace gases and gas engines worked thereby, slag, ironfounding, cast steel, electric furnaces, rolling mills, and necessarily the Bessemer, Thomas and Siemens-Martin processes. The book concludes with a review of the development of the iron trade in different countries. The author remarks that the rapid industrialisation of Germany is often commented upon, but, he says, the remarkable thing is not the position that country has attained in comparison with other lands rich in coal, but that it should ever have sunk so low as it did. He shows that the growth of the German pig iron production, if rapid, has been steady. The advance was due in the first place to the removal of the fetters —such as internal customs barriers—which had previously restrained growth; then the war of 1870 helped directly and indirectly; finally, in 1879, protective duties were laid upon raw and finished iron, and since that date the German iron industry has never looked back.

SHORT NOTICES.

Photo Electricity. By Stanley Allen. London: Longmans, Green and Co. Price 18s.—Since the publication of the first edition of this book in 1913 many of the ideas relating to atomic structure and views regarding the relationship between matter and radiation have undergone considerable modification, but the facts concerning photo-electricity as originally recorded by the author and the deductions drawn from them remain substantially true to-day. The most important advance in the subject, the author states, has been due to the elaborate experimental investigations of Millikan, who has proved that photo-electric emission conforms exactly to the Quantum theory and provides one of the most accurate values for Planck's constant. Other work of importance is also described and an account is given in a separate chapter of the development of the photo-electric cell and its application in photometry. A bibliography is given of all the relevant papers published between 1913 and 1924, and at the end of each chapter there are references to books and articles bearing on the subject. The author's chief aim in preparing this new edition of the book has been to give a connected view of the subject of the liberation of electrons by ordinary and ultra-violet light and to show how the experimental facts may be expressed in terms of modern theories of matter and radiation.

Oscillographs. By J. T. Irwin. London: Sir Isaac Pitman and Sons, Ltd. Price 7s. 6d.—Those who are interested in oscillographs and who are not entirely ignorant of mathematics, will no doubt welcome this book, which deals with various kinds of instruments of this class. It has been written for students of average ability, but one section demands rather more mathematical knowledge than many electrical students possess. For the most part, however, the mathematics do not go beyond the simplest integral and differential calculus. There are four chapters which are devoted to fundamental principles, types of oscillographs, errors of indication, and methods of damping, and the cathode ray oscillograph, the last chapter being, in our opinion, the most interesting.

Practical D.C. Armature Winding. By L. Wollison. London: Sir Isaac Pitman and Sons, Ltd. Price 7s. 6d. net.—Many books have been written on armature winding, but they are not all written on practical lines. The author of the present volume, who is foreman of the winding departments of Bruce Peebles and Co., Ltd., and Lecturer in Armature Winding at the Leith Technical College, deals with the subject from the point of view of those who desire to learn how to wind armatures. He has, moreover, reduced the winding formulæ to simple, but reliable terms, easily understood by the practical worker. Besides giving a good deal of useful information on armature winding, the volume also contains a chapter on faults and tests. From a practical point of view, the book is one of the best we have seen.

BOOKS RECEIVED.

Diesel Maschinen. Vol. II. Berlin: V.D. I. Verlag G.m.b.H., S.W. 19. Price 8 Marks.

Stars and their Uses. By E. B. Leggett. Cambridge: W. Heffer and Sons, Ltd. Price 3s. net.

The People's Year Book, 1926. Manchester: The Co-operative Wholesale Society, Ltd., 1, Balloon-street. Price 3s. net.

Insulated Electric Cables: Vol. I., Materials and Design. By C. J. Beaver. London: Ernest Benn, Ltd., 8, Bouverie-street, E.C. 4. Price 36s. net.

Calvert's Mechanics' Almanac, 1926. Edited by F. Nasmith. London: John Heywood, Ltd., 20–22, St. Bride-street, E.C. 4. Price 6d. net.

The Disease of Unemployment and the Cure. By Sir Ernest W. Petter. London: Hutchinson and Co. (Publishers), Ltd., Paternoster-row, E.C. Price 1s. net.

Report on the Economic and Industrial Conditions in France. By J. R. Cahill. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 8s. net.

The Lake Plateau Basin of the Nile. By Dr. H. E. Hurst, Controller of the Physical Department, Ministry of Public Works, Egypt, being Physical Department Paper No. 21. Cairo: Government Publications Office, Ministry of Finance (Dawâwin P.O.). Price P.T. 10. 1925.

Motor Generators for the Rugby Wireless Station.

ON the score of reliability, flexibility and minimum voltage ripple, it was decided by those responsible for the design of the new Rugby wireless station that motor generators would be the most suitable for supplying the extra high-tension direct current to the plate circuits of the valves. The large capacity of the aerial, with which we have already dealt—see THE ENGINEER, September 5th, 1924—naturally calls for power plant of considerable output, and, needless to say, reliability is of paramount importance. It was estimated by the Post Office engineers that, at the outset, the combined demand of the telegraphy and telephony sections of the station would be 84 ampères at 12,000 volts, whilst at a later date it might be desirable to raise the pressure to 18,000 volts, with a view to increasing the signal strength.

Three motor generator sets—see Fig. 1—each rated at 6000 volts and 84 ampères, were accordingly ordered from the British Thomson-Houston Company. Provision has also been made at the station for the installation of a fourth set, so that when three machines are required for transmitting messages a stand-by machine will be available for use in case of emergency, and it will also be possible to put the sets out of commission in rotation for cleaning and overhaul. The power supply requirements of a large valve wireless station are somewhat exacting, for even with the largest size of water-cooled valves available, it is necessary to run many valves at high temperature in parallel, and the failure of a single valve is equivalent to a dead short circuit on the machines. Hence it was essential that the motor generators should be capable of withstanding frequent short circuits, and that the protective gear should be able to open the circuit in time to prevent serious damage at any point of the installation. It is also desirable, in order to ensure reasonable continuity of transmission, that the machines should be ready for load again immediately after a fault has been cleared. Other conditions that had to be met were that the voltage regulation of the

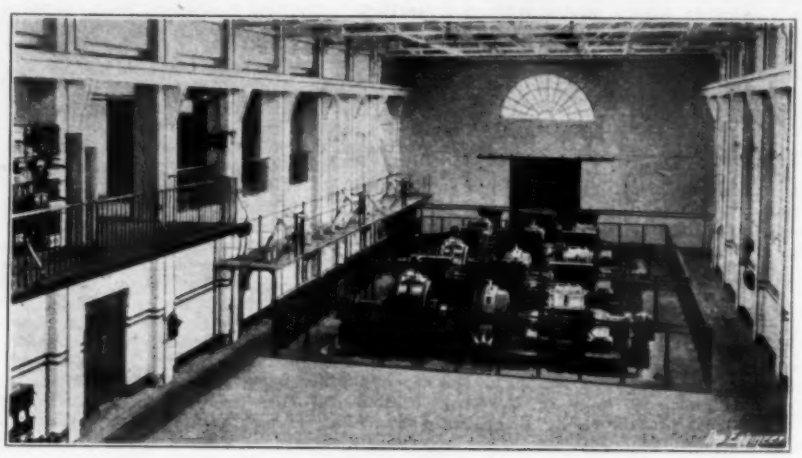
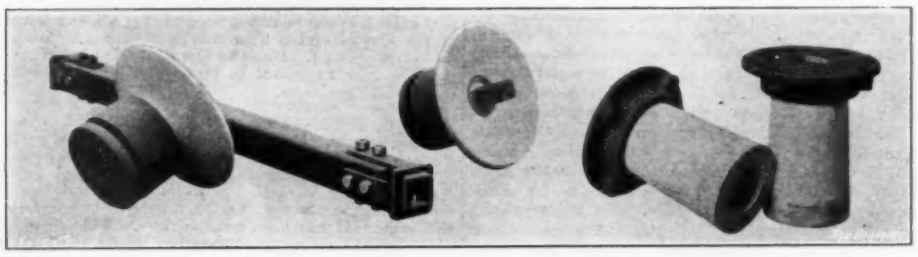


FIG. 1—MOTOR GENERATORS AT THE RUGBY WIRELESS STATION



FIGS. 2 AND 3—TORQUE ROD AND BASE-PLATE INSULATORS

generators should not exceed 5 per cent., that the amplitude of harmonics or tooth ripples in the voltage should not exceed ± 5 per cent., and that, in addition to withstanding heavy overloads, the machines should be capable of dealing successfully with the very rapid load variations arising from the keying on the grid circuits of the valves. Under the automatic conditions of working that are to be adopted Morse signals will be transmitted at a rate equivalent to forty interruptions per second. To suit the routine service it will be necessary to arrange for either of the three motor generators to be operated singly or any two or three of the sets in series. For all the circuits connected to the 18,000-volt line a ten-minute test at 40,000 volts and a periodicity of 50 cycles per second was specified.

Each of the three motor generator sets installed consists of five units. In the centre of each set—see Fig. 1—is a 640-kilovolt-ampère 2200-volt three-phase self-starting synchronous motor, whilst on each side of the motor there is a 250-kilowatt 3000-volt shunt-wound generator, permanently connected in series, so as to produce a pressure of 6000 volts. At each end of each set there is an overhung exciter rated at 8.5 kilowatts. The master exciter is a 110-volt flat-compounded machine, while the exciter for the synchronous motor is rated at 65 volts and 131 ampères, and is capable of providing the maximum excitation required for a 90 per cent. leading power factor on overload. Each set weighs approximately 38 tons.

Power is delivered to the station by the Leicestershire and Warwickshire Electric Power Company in the form of 12,000-volt 50-cycle three-phase current, which, after passing through the usual main oil switches, is led to a group of three star-delta starting cubicles, which are placed on a gallery immediately over three oil-cooled transformers supplied by Johnson and Phillips, Ltd., to the order of the British Thomson-Houston Company, Ltd. Each starting cubicle is equipped with isolating links, two oil circuit breakers, overload and low-voltage trips, an ammeter and power factor meter and current and potential transformers. The first oil circuit breaker, which is a standard piece of apparatus, serves to connect one end of each of the three primary windings of the transformer to the line. The second oil switch is of the four-pole double-pole type, with a double escutcheon. On closing the starting throw of the switch, the inner ends of the transformer primary windings are connected together. The operation of a sliding interlock bar then trips the starting throw, and allows the running throw to be closed so as to connect the transformer primary windings in delta. With the primary connected in star, the secondary pressure is 1270 volts. This pressure is applied directly to the stator winding of the synchronous motor, but on changing to the delta connection, the pressure is increased to 2200 volts for normal running. Each transformer secondary is connected directly to the corresponding synchronous motor stator winding by means of a three-core cable, passing through a duct in the foundations without the interposition of any switches or instruments, and the star point of the stator winding is connected to the machine base-plate.

In order to limit the dielectric stress in each armature to that imposed by a pressure of 3000 volts, the lead connecting the two armatures in series is connected to the base plate through a low-resistance earthing relay, and as one end of the direct-current line is earthed, it follows that with the three sets in series, the first bed-plate will be at a potential of 3000 volts above earth, the second at 9000 volts, and the third at 15,000 volts. Each bed-plate and the remote mechanically controlled gear of each set is therefore insulated for a normal working pressure of 15,000 volts to earth, and the transformer secondary windings and the connecting cable and trifurcating boxes are designed for the electrical stresses involved in a 2200 three-phase circuit, with the neutral point held at a potential of 15,000 volts above earth. The type of insulator used for insulating the bed-plates of the motor generator sets is shown in Fig. 3.

By the side of each motor generator set and fixed on an auxiliary base plate insulated in the same way as the main base plate, there is a set of control gear, consisting of field switches and rheostats for the exciters and generators, two high-speed circuit breakers with current-limiting resistances for the main generators, a low-resistance relay for the base plate connection, and a low-voltage relay with a gong for the bearing temperature alarm. The high-speed circuit breakers and the generator field switches or contactors are electrically operated from the master exciter of the set, but the control switches for their operating coils, together with the spindles of the field switches and rheostats are mechanically operated by means of insulating torque rods—as shown in Fig. 2. For each exciter there is a voltmeter and ammeter on the control panel, but the electrostatic voltmeter for the generator is mounted on top of the generator frame at the point where the leads are taken off to the isolating switch gallery—as shown in Fig. 1.

Each high-speed circuit breaker is set for instantaneous tripping on about five times full load, but a current-limiting resistance mounted in the frame below the breaker prevents the full circuit voltage being established across the contacts. Moreover, interlock contacts immediately trip the generator field contactor of the set and then trip the field contactors of all the other sets working on the line. In the event of an overload or fault occurring in the circuit external to the machines, all the circuit breakers open independently on overload in about one-fiftieth of a second, and the generator field current is reduced to zero in about one-half of a second. A local fault on a set opens the circuit breaker and field switch of that set in the periods of time specified, thus reducing damage to a minimum, and the suppression of the voltage on the other sets occurs a fraction of a second later. In order that the field may be suppressed as rapidly as possible, the generator field contactors are made to open the circuit directly and without the use of discharge resistances. The high-speed circuit breaker comprises a holding magnet system and a moving armature biassed to the open position by a heavy spring. By energising the closing coil, the armature is moved to the closed position and is held in that position by a separate "holding coil." The holding magnet has a so-called bucking bar in its pole face, and is so connected that the main current

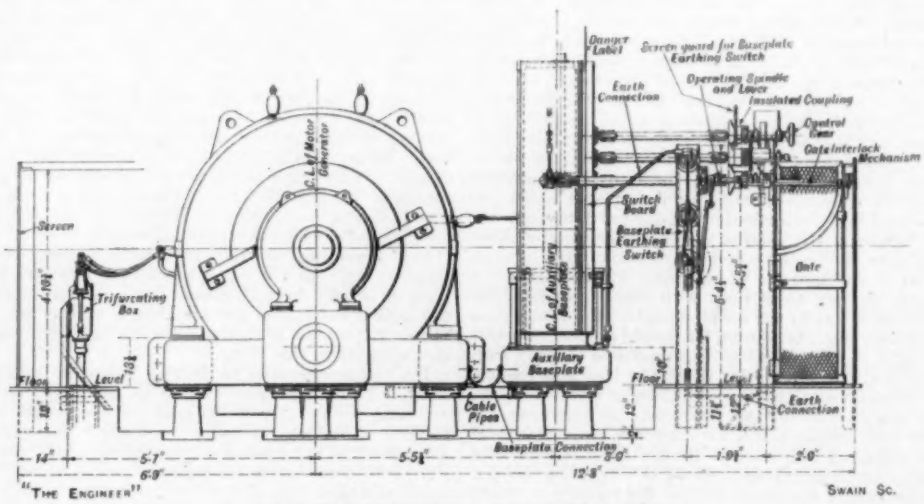
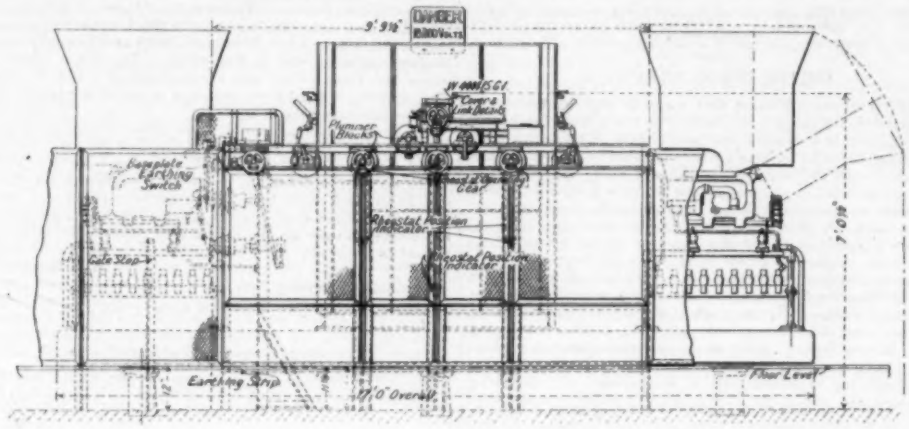


FIG. 4—MOTOR GENERATOR AND CONTROL GEAR

or a portion of it passing through the bucking bar will on heavy overloads deflect the magnetic flux of the holding coil, so that the armature is released and returned rapidly by means of the spring to the off position.

Owing to the absence of mechanical latches and the high ratio of spring tension to armature inertia, high speed and reliable operation are ensured. When used for heavy currents the bucking bar is connected in parallel with an inductive shunt, so that the rate of increase of the bucking bar current is greater than that of the current in the main circuit. As the circuit



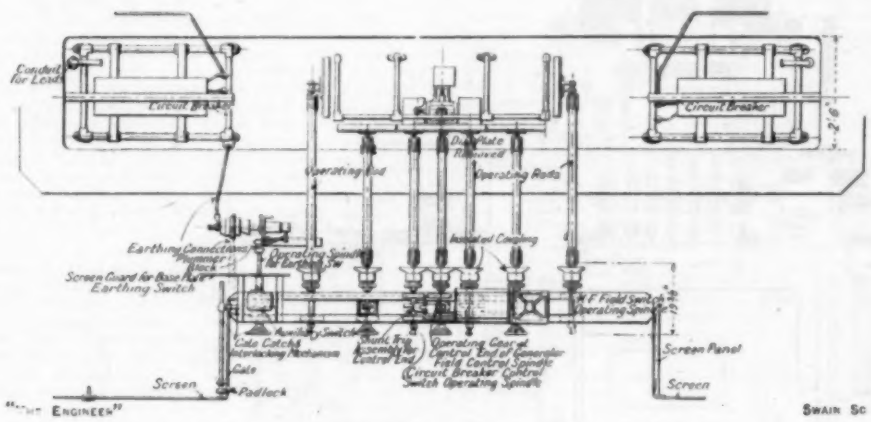


FIG. 5—OPERATING MECHANISM AND CIRCUIT BREAKERS

breaker does not make contact until the closing mechanism has returned to the off position, it is free to operate immediately, if closed on a fault. For closing the breaker manually, a detachable lever is provided, but the free trip feature of the breaker is still maintained. Powerful magnetic blow-out coils and large arc chutes enable the breaker to clear heavy faults.

Each motor generator is surrounded by an expanded metal screen—see Figs. 1 and 5—35ft. long, 19ft. wide and 5ft. high. The screen is bonded to the main earth system of the station and is continued in the form of an open-mesh wire guard, extending through the foundation below the machines, and is bonded

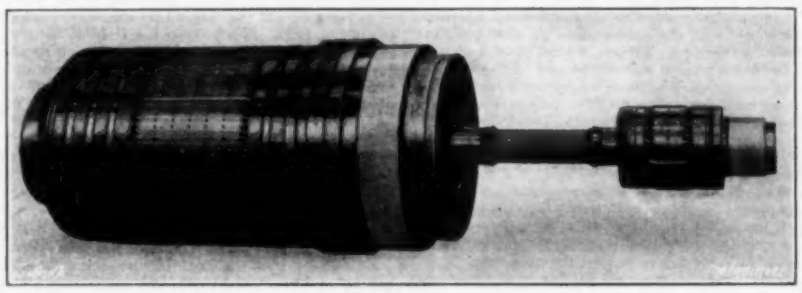


FIG. 6—GENERATOR ARMATURE

to the supporting frame of the main screen. Normally the gate in this screen is barred by a steel rod, and only when this rod is in this position can the associated auxiliary switch be moved to the position which allows the set to be put into operation. Moreover, coupled to the gate-blocking mechanism is a switch which connects the base plate of the set to earth before the gate can be opened. This switch not only acts as an additional check on the correct operation of the electrical interlocks, but also dissipates any static charge remaining on the set. As it is in full view of the operator, it gives a visual indication that the conditions are safe. Padlocks with different keys are provided on the gates to facilitate supervisory control, and there are master keys for use in case of emergency. Apart from the two main direct-current cables and the three-core alternating-current cable, there are no electrical connections between the outside and inside of the machine screen.

As the machines are not accessible when they are in operation, a thermostat is fitted to each bearing. The liquid container of each of these thermostats is placed in a hole of the white metal of the bearing bush, and if a temperature of 95 deg. Cent. is reached vapour pressure, acting through a capillary tube on bellows on the side of the bearing, trips a toggle link and by interrupting the circuit of a low-voltage relay causes a gong on the control panel to ring. A second pair of contacts on the toggle mechanism lights a red lamp on the bearing that is at fault.

The extra high voltage and the exacting load conditions made it necessary to design the generators on somewhat unusual lines. In order to employ a single-turn armature winding with a low voltage per turn, but with commutator segments not inconveniently narrow, and in order to keep the brush brackets as far as possible apart, a bipolar design was adopted, with an armature and commutator of the same diameter of the commutator. Radial commutator lugs, which are always troublesome on extra high-voltage machines, have been eliminated.

The commutator clamp ring, bolts and shell, the bearing and the base plate at the commutator end and the bus-rings are well prptected by insulating shields, so that if a flash is produced it is practically impossible for it to strike to earth or to metal connected to the base plate. Commutating poles of liberal section and with air gaps behind them ensure good operation when the machines are running on heavy overloads; whilst field distortion, which makes electrical machines liable to flashing by increasing the maximum volts per commutator segment, has been reduced to a small amount by a distributed pole face winding which opposes the armature ampère turns. A view of one of the generator frames is given in Fig. 7; whilst Fig. 8 is a section through one of the main generators. By reason of the small full-load current, viz., 84 ampères, the number of pole face turns is much larger than usual, and the two-pole construction involves a long coil span, and radial brackets bolted to the frame have therefore been used to support the pole face winding at several points. The usual method of splitting the generator frames on or near the axis of a commutating pole has been departed from, the division being through the centre line of the main poles—an arrangement which avoids awkward joints in the pole face winding and allows the use of main pole punchings and field spools similar to those for a four-pole machine of the same diameter. The poles, however, are assembled in pairs with the pole tips almost touching.

No matter how well a normal generator may operate on steady loads, it will spark when a heavy load is suddenly applied or removed from it, because the commutating flux cannot be built up or removed at a sufficiently high rate. In the generators under consideration, however, an undamped path for the commutating flux has been provided in the form of a

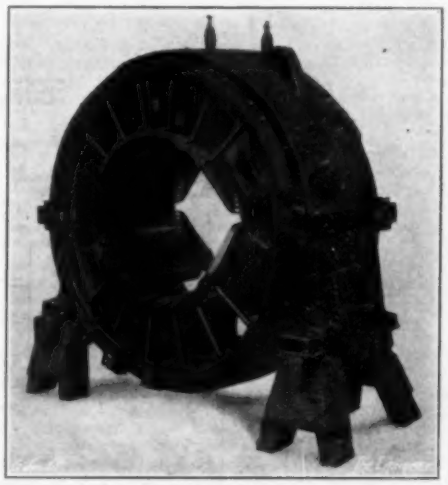


FIG. 7—GENERATOR FIELD FRAME

packet of laminations, lining the inner circumference of the frame. The main poles, like the commutating poles, are fully laminated and are built up so as to avoid eddy current paths in bolts and clamps. In order to reduce the voltage ripple to a minimum amount, the designers paid particular attention to the most favourable spacing of the armature and pole face slots, and the two armatures belonging to each set are coupled with the teeth staggered so that the ripple in the voltage of one armature is largely neutralised by reason of the fact that it is out of phase with the ripple in the voltage of the other armature.

The bi-polar design naturally leads to a heavy frame on account of the large flux per pole. It also entails a large armature winding overhang, and the use of punchings mounted directly on the shaft, but these drawbacks are more than offset by the advantages gained in other directions, and, in spite of all the peculiarities, tests have shown that the machines have an efficiency of 87·6 per cent.

Orthodox practice has not been departed from in the design of the synchronous motor, which has its exciter permanently connected to the slip rings, the motor's excitation being controlled by varying the exciter's field. A substantial squirrel-cage winding on the rotor poles enables the motor to start easily and to attain speed in a short space of time, and on exciting the rotor the machine promptly pulls into step. For supporting and insulating the bed-plate, hollow-glazed white porcelain cylinders—as shown in Fig. 3—are used. They are 12·5in. long and 7·75in. in diameter at the base, and they are cemented into cast iron caps with flat machined tops. To provide a certain amount of elasticity and to permit of adjustment, discs of fibre are placed on the caps, which were screwed to the machined pads on the underside of the base plate, whilst the latter was supported in position on timber baulks. Cement grout was then run into the recesses which had been left in the concrete foundation blocks, until the lower ends of the cylinders were embedded to a depth of about 2in. To allow

for expansion with rises of temperature, the screws in the end groups of insulators were released after the grout had set. Steadying insulators are used at the four corners of the machines, and the remaining twenty-eight insulators of each unit are placed under the points where weight is applied to the bed-plate. As measured on site the insulation resistance for each bed-plate is between 100 megohms and infinity.

During the manufacture of the sets special care was taken in the balancing of the rotating parts. Each armature and rotor was dynamically balanced before erection. As a final check, all the tests, including the short-circuit tests, were carried out with the base plates resting on blocks, but not clamped down. The construction of the torque rods used for operating the control gear of the sets will be obvious from the illustrations. The flanged porcelain which provides the insulation proper is reinforced by a treated mahogany rod which is really sufficient to withstand the voltage, but its main function is to maintain an ample distance between the control panel and the operating frame. The square rod and socket joints at the ends of the torque rods allow a little play in each direction, and prevent bending as the result of slight errors in alignment. The control and trip circuits on the sets depend in each case on the master exciter of the set, whilst all interlock circuits external to the set depend on a 220-volt battery supply. As no electrical connection is permissible, the tripping of the field switch of a set is passed on mechanically from the panel on the auxiliary base to the operating frame.

The hand wheel and spindle on the operating frame, the torque rod and the control switch behind the panel on the auxiliary base are coupled together and rotate together and also operate a set of auxiliary switches on the control frame. In turning this spindle to close the field contactor control switch, a spring-controlled arm is carried round with the spindle, and this arm is then held in the set position by a clutch until it is released by the plunger of the trip coil, and a corresponding spring-controlled and trip-coil-released arm behind the control panel is set in the same way. With both of the spring arms set, the spindle, and with it the control switch, can be operated freely by hand, so as to apply field current to the generators or to take it off. On being released by its trip coil, either spring arm returns the spindle to the off position, and by means of the auxiliary switches and interlock circuits inaugurates the necessary operations on the other sets. An auxiliary switch opened by hand prevents a set that is out of commission interfering with the other sets that are at work, but this switch is closed automatically when the former set is put into operation.

On the occasion of some 18,000-volt short-circuit tests, made on October 16th of last year, on the plate circuits of the valves, some instructive cinematograph records to show the behaviour of the brush gear on one of the 6000-volt sets were made. The three motor generators were connected in series and excited at the normal pressure to give 18,000 volts; a manually-operated isolating switch in the valve room being connected, so that when closed it produced a dead short circuit on the 18,000-volt line. The cinematograph camera was operated for taking sixteen pictures per second, each exposure lasting $^1/_{32}$ of a second. Two short-circuit tests were taken in succession. Enlarged sections of the film relating to these tests have been sent to us, but unfortunately they are scarcely suitable for reproduction. They show, however, that the machines cleared the short circuit with remarkable ease, the flash at the commutators being very small and of very short duration. After the short circuit, we are told, no attention was necessary beyond resetting the circuit breakers and the field switches from outside the screen work.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

EMPIRE TRADE EXPANSION.

SIR,—The announcement that a special representative is to be appointed to keep your readers in touch with continental development is a welcome one, and I write to submit that the principle might be extended where possible to keep them also in touch with the ultimate operation of many types of plant that are reported in your columns at the time of shipment to the Colonies or elsewhere, and are then, generally speaking, heard of no more. A good case in point is the set of two large gas pumps supplied to the Murray River irrigation scheme about two years since. This case is of particular interest in that certainly irrigation will in the future play a most important part in developing the Empire, and also there is a confusion of thought in respect of this particular method of water-raising that so far as I am aware attaches to no other class of apparatus in accepted use. Having worked closely on the proposition since the Armistice, I have been surprised at the general lack of knowledge that surrounds the explosion type of pump, even in enlightened quarters, and also at the vast amount of unfounded prejudice that attaches thereto, and which an authentic account of the satisfactory working of a modern plant would go far to dispel.

Then, too, there are frequently special locomotives and other types of machinery which figure on the screen of your pages and "disappear," and while doubtless the manufacturers interested keep in close touch with the performance of their products, others interested at the time, I think, frequently lose sight of their possibilities in the press of current business. A "reminder" in the shape of some account of their behaviour under practical conditions of working, with some detail as to cost of operation and maintenance, where possible, would, I feel practically assured, do much to keep this interest warm, and in time would result in a widening of the field of demand. Naturally, such a suggestion must have the sympathetic assistance of the makers and users, and one realises that ir some cases publicity may not at first blush appear desirable, particularly where costly patents are concerned, but is not this, after all, a short-sighted policy under present conditions, and may it not be suggested that the long view would ultimately benefit both the manufacturer and the nation, since it is only, after all, a form of advertisement calculated to bring much-needed "grist" to the home "mills," and first of all to his own?

COLONIAL TRADE.

January 5th.

THE BRITISH STEAM LOCOMOTIVE, 1825 TO 1924.

SIR,—In reply to Mr. J. Poole's letter in THE ENGINEER of the 1st inst.

4–4–4 *Tank Engines.*—There were five in this country with inside cylinders, three of which were on the Wirral Railway. The word "four" on page 394 of the issue for October 16th last, was a slip on my part, for which I apologise.

The 4–4–4 type with outside cylinders for the Buenos Aires Western Railway were built by Beyer, Peacock and Co., but those for the Buenos Aires and Pacific Railway—Nos. 2301–2324—were built by the North British Locomotive Company, Ltd., in 1907–1910.

2–4–2 *Compound Tank Engines.*—These engines on the Belfast and Co. Down Railway were afterwards altered by the addition of leading bogies, and most, if not all of them, were converted to non-compounds. They were broken up about five or six years ago. On the 3ft. gauge section of the Belfast and Northern Counties Railway there were only two 2–4–2 compound tank engines, by Beyer, Peacock and Co., in 1892. The writer had first-hand knowledge of both of the above classes of compound tank engines, as he worked at the detailed drawings when they were designed. Two more were subsequently made for the 3ft. gauge in 1908–9, but not by Beyer, Peacock and Co.

4–4–2 *Compound Tank Engines.*—The Argentine engines did not come within the limits of the articles, and were not mentioned. Owing to the limitations of space, many interesting types of engines, built by British builders for the Argentine and many other countries abroad, had necessarily to be omitted.

2–6–0 *Tank Engines.*—There was only one, which can be described as a main line engine, with the 2–6–0 wheel arrangement, viz., that on the Wrexham, Mold and Connah's Quay Railway, as mentioned in the articles. The 0–8–0 engine, to which Mr. Poole refers, was a conversion of a 0–6–2 engine. Both in their original form had been of the 0–6–0 type, afterwards completely reconstructed.

The Cork, Bandon and South Coast (Ireland) engines, 5ft. 3in. gauge, built by Beyer, Peacock and Co., had the 4–6–0 and not the 2–6–0 wheel arrangement, as mentioned by Mr. Poole. There were a few 2–6–0 3ft. gauge tank engines on the Tralee and Dingle and other Irish narrow-gauge railways, but these, like several other small engines of light branch railways, were not included in my articles; otherwise there would have been no end to the latter.

E. L. AHRONS.

Nottingham, January 2nd.

[This correspondence must now cease.—ED. THE E.]

ROAD CORRUGATIONS.

SIR,—With reference to the letter by Mr. Alfred Weale in your copy of January 1st on road corrugations, what he says was proved to be true many years ago when an investigation described in your paper—I forget the date—was made into wave marks in the London County Council tram lines underneath Kingsway. It was conclusively proved, according to the previously mentioned article, that the bright marks across the rails, which were about 2in. pitch, were produced exactly as he describes in his experiment, *i.e.*, by a wave or hillock travelling along the rail in front of the tram wheel. This hillock grew until it contained sufficient elastic energy to allow the wheel to over-ride it, when another hillock formed. This will be due, I suppose, to using too small a wheel or too soft a rail.

A similar set of bright mark about 2ft. pitch are sometimes seen on railway lines, probably owing to the same cause.

THOS. H. WEBSTER.

London, S.E., January 4th.

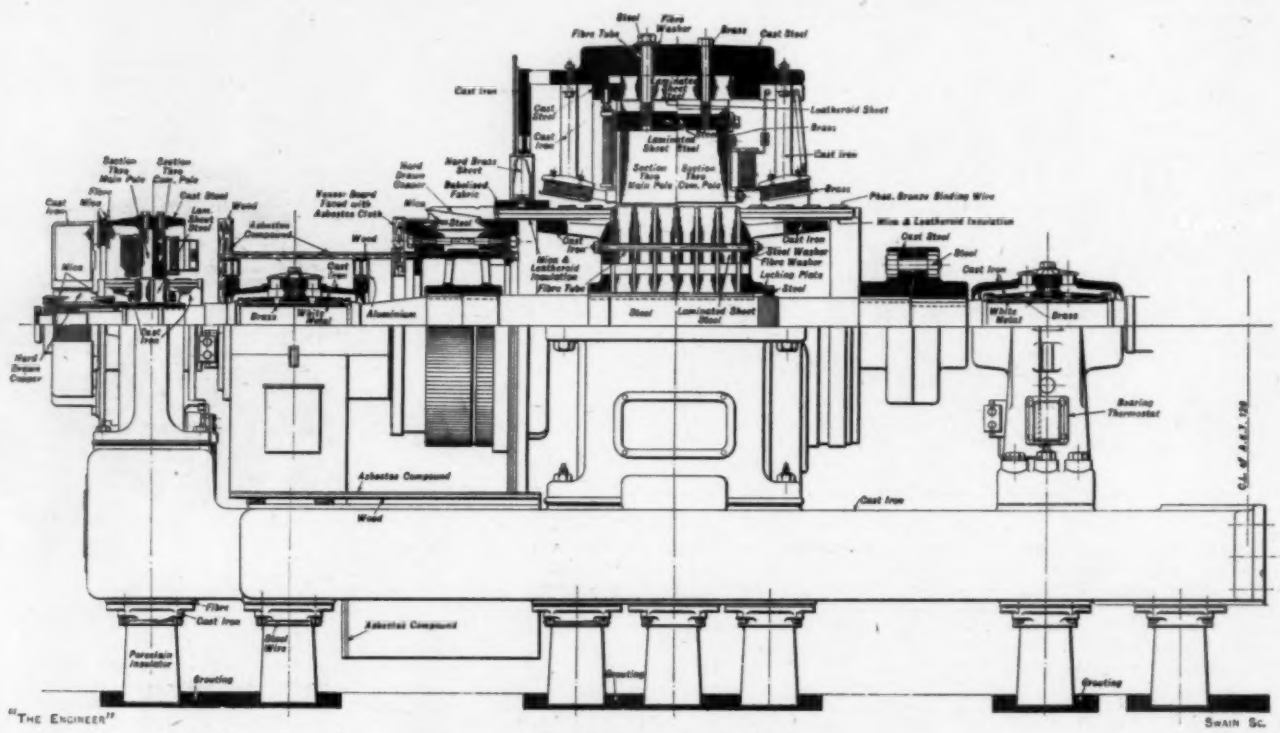


FIG. 5—SECTION THROUGH GENERATOR

ON account of the rapidly increasing demand for electricity at Sutton Coldfield, the Borough Electricity Committee has approved a scheme for the improvement and alteration of the plant, and is proposing to ask the Electricity Commissioners for permission to borrow £28,650 for the purpose of carrying out the work. In a special report, the electrical engineer states that whilst the plant now in existence should meet the demand for this winter, it is advisable to make provision at the Riland-road power station and at the Lime-grove sub-station for the demands of 1926–1927. It is estimated that during the next five years the demand on the undertaking will increase by 100 per cent., and the electrical engineer is of opinion that the Committee should make provision for meeting that demand by duplicating the present bulk supply system from Birmingham, and also by the replacement of the three reciprocating sets at the Riland-road power station by a steam turbine, which, in addition to increasing the capacity of the station without additional boilers or buildings, would generate electricity at about half the present cost.

Railway Matters.

ON page 517 of our issue of May 8th last we announced the appointment of Sir Josiah Stamp to the newly created position of president of the London, Midland and Scottish Railway. Sir Josiah has been spending some time during the last few weeks in the offices at Euston, and entered fully on his new duties on Monday last, the 4th inst. Mr. Burgess retains his office as general manager.

WE have reason to believe that informal discussions are taking place between representatives of the railway companies and of the trading interests in order to agree to the figure as to the expenditure of "A" year. Such an agreement would considerably shorten the proceedings before the Railway Rates Tribunal, and thus hasten the date when the new standard charges can come into operation.

QUITE the most serious railway accident of the past quarter occurred on December 19th at Linlithgow, on the Edinburgh-Glasgow main line of the London and North-Eastern Railway. Whilst a goods train was shunting, a down express passenger train ran into it. There were few personal injuries. If the goods train was actually shunting at the time the signals must necessarily have been against the express, and so must have been overrun by the latter.

THE Cumberland County Council is adding colour to the concrete used in the building of a bridge between Penrith and Ullswater so as to harmonise with a house nearby, which is built of pink sandstone. This piece of news revives the recollection that the Manchester, Sheffield and Lincolnshire Railway, later the Great Central, had a signal-box between Penistone and Sheffield painted green so as to harmonise with the surrounding woodlands. The success of the experiment led to the railway company making green the predominate colour in station decoration.

AT the last meeting of the Institution of Railway Signal Engineers a paper by Mr. H. E. Morgan and Mr. F. J. Hookham jointly on long-burning signal lamps was read and discussed. Prior to the introduction, in 1903, of this American idea, the signal lamps on British railways were taken to the station lamp-room each morning, cleaned and trimmed during the day and then lighted and taken to the signal as dark approached. As that course had to be followed every day, it will be appreciated what economies were possible when it was found that a lamp could be made which would burn continuously and without any attention for eight days. There are now about 60,000 of these lamps on British railways, of which 38,000 are on the Great Western. Some of the Adlake lamps, installed on the Midland twenty years ago, are still in work and giving satisfaction.

THERE is no entry in the list of New Year Honours of immediate interest to British railwaymen, except that General Sir Herbert Lawrence, K.C.B., a director of the London, Midland and Scottish Railway, has been made a G.C.B. (Military Division). Two former railway directors —Mr. F. S. Jackson, of the late Great Northern, and Mr. E. R. Turton, of the late North-Eastern—have also received honours. In the India Office list are the names of Mr. F. A. Hadow, formerly of the North-Western of India, but now of the Indian Railway Board, who has been knighted, and Mr. J. R. D. Glascott, the agent of the Burma Railways, who has been made a Commander of the Indian Empire. It will be opportune to mention here that Mr. J. W. Hills, the recently elected member for the Ripon Division, was a director of the former Midland Railway and was the leading spokesman for the railway companies in the discussions in the House of Commons—where he then represented Durham—on the Railways Bill of 1921.

ASKED, shortly before Parliament rose, about the condition of Denbigh Station, the Minister of Transport said that it was not a case in which he had compulsory powers. In reply to another question, Colonel Ashley said that under the Railways Act, 1921, he had power to take some steps, but the trader must first take action. In that relation, we would like to point out that Sec. 16 (1) of the above-named Act recites: "With a view to securing and promoting the public safety . . . the Railway and Canal Commission may, on the application of any body of persons . . . by Order require any railway company . . . to afford such reasonable railway services, facilities and conveniences . . . including the provision of such minor alterations and extensions and improvements of existing works as will not involve in any one case an expenditure exceeding one hundred thousand pounds. . . ." The next clause protects the railway company thus: "If, on any such application, a company satisfies the Railway and Canal Commission that under all the circumstances the capital required for the purpose cannot be provided or expended as proposed without prejudicially affecting the interests of the then existing stockholders, the Order shall not be made."

WERE it not for the fact that a passenger, who received a shock in the collision of June 14th at Baker-street, was suffering from a fatty degeneration of the heart, so that his subsequent death was officially regarded as the result of the accident, last year would have received, along with 1901 and 1908, the credit of not having had a single train accident in which a passenger was killed. Since 1850 there have been four years—1887, 1909, 1917 and 1925—in which there was only one accident in which a passenger was killed; in another four years—1914, 1918, 1920 and 1923—there were only two fatal accidents; whilst in 1865, 1879, 1885, 1886, 1893, 1894, 1896, 1902, 1904, 1919, 1921 and 1922 there were only three. Some of the paradoxes of railway accidents are to be found in the figures for 1879, 1887, 1894 and 1917. The first-named was the year of the Tay Bridge disaster. Up to its occurrence on December 29th, three days before the end of the year, when 73 passengers were drowned, there had been only two fatal accidents, in each of which one passenger was killed, or a total for the year of two. In 1887 there was only one fatal accident, but in it 25 passengers lost their lives. It occurred at Hexthorpe. The Chelford disaster —14 killed—was nine days off the end of the year 1894, prior to which there had been one fatality to a passenger in a train accident. In 1917 there was only one fatal accident, but that was the one at Ratho, when 12 were killed.

Notes and Memoranda.

TESTS of 168 riveted joints, carried out at the University of Wisconsin during the last three years, indicate that countersunk rivets are just as strong in shearing and bearing resistance as bottom-head rivets. There are differences between the two in the deformation of the joint under load, especially in the slip, but no recognisable difference in ultimate strength.

WHAT is claimed by the *S.A. Mining and Engineering Journal* as a world's record in mining was set up by the Crown Mines, Transvaal, during November. One of the main haulages, measuring 10ft. by 16ft., was advanced 253ft. in 27 single shifts, or at the average rate of 9.37ft. per shift. Six drilling machines were used, and each drilling shift was four hours.

AFTER trying ordinary lattice towers, the hydro-electric department of Tasmania has now adopted "Kay" towers for the new high voltage line between Waddamana and Burnie, which will be worked at 80,000 volts. This tower, by Callender's Cable and Construction Company, Ltd., England, is of weldless steel tubes. Between 800-900 towers will be required for the new line.

SOME investigations carried out by the American Bureau of Mines were devised with the object of increasing the proportion of large coal produced by blasting. It was found that by changing from the standard practice of drilling the hole 24in. below the draw slate, slanted upward at the rate of 3in. per foot of drill hole, to one in which the hole was placed 10in. below the draw plate and drilled at slant of about ½in. per foot of drill hole, an increase of 5·1 per cent. was obtained.

A PAPER on "The Limits of Inflammability of Firedamp and Air," by M. J. Burgess and R. V. Wheeler—Safety in Mines Research Board Paper No. 15, H.M. Stationery Office, Adastral House, Kingsway, London, price 6d. net—which has just been published, should be read in conjunction with Safety in Mines Research Board Paper No. 8—"The Ignition of Firedamp," by H. F. Coward and R. V. Wheeler; for there are two conditions essential to the production of an explosion of firedamp and air in coal mines: an explosive mixture and an adequate source of ignition. The second condition was dealt with in Paper No. 8, and the first condition forms the subject of the present paper.

SPEAKING at a meeting of the Royal Society of Arts, Lieutenant-Colonel Sir A. H. Burgoyne said that the present system of cambering roads from the centre to the edges was an increasing danger. Heavily loaded lorries were forced on such roads to keep to the crown, and he had seen many cases in which, on drawing to one side to allow a faster vehicle to pass, the back wheels had skidded down the camber in a most alarming manner. Roads should be bedded as nearly level as is commensurate with proper drainage. Round the corners roads might well be banked, and such banking would do more even than white lines to keep traffic in its proper position. The ideal road, he added, was, of course, a concrete surface road, but the expense of this is very high.

AN exceptionally large ingot mould was recently cast by Sir W. G. Armstrong, Whitworth and Company, Ltd., at their Openshaw Iron Foundry. The dimensions and weight of the mould are:—Internal diameter, top 72½in., bottom 80in.; external diameter, top 113in., bottom 121in.; length, 205in.; and weight, 109 tons. One hundred and thirty tons of molten metal were used to cast this. The metal was teemed into the moulds in ten minutes, and the casting was afterwards fed for twelve hours. This is the largest mould which has been cast in the company's foundry, and probably one of the largest produced in the country. It is interesting to note that in February, 1922, the Brightside Foundry cast an ingot mould weighing 110 tons, the inside dimensions being 108in. by 68in. by 148in. long.

THE purpose of an investigation being conducted at the Pittsburgh, Pa., experiment station of the American Bureau of Mines, Department of Commerce, is to determine whether the character of the precipitates forming in boilers may be made to assume a form in which they do not attach themselves to the walls; and if the material in the boiler wall exercises any influence. Data have been obtained on the non-condensible gases which are carried off in the steam, and the correct relationships to be maintained when carbonate becomes unstable and phosphate must be used in boiler water conditioning. The use of phosphate may form objectionable deposits. This condition is being looked into. Further, indicators used in titrating boiler waters do not necessarily represent the true phosphate or carbonate concentration. Means of controlling this indication are being investigated. Conditions which may bear on wet steam are being watched in the hope that definite information may be acquired on the factors influential in wet steam development and thereby control be obtained over them.

COMMENTING on the explosion of a steam pipe in a Lancashire mill, the Engineer Surveyor-in-Chief of the Board of Trade makes the following remarks as to the effectiveness of steam traps:—The attendant, who was unfortunately killed, had worked on the engines for many years without mishap, and was apparently a careful and reliable man. Misled probably by the effectiveness of the steam trap on many previous occasions he apparently did not assure himself that the steam pipes were clear of water before opening up the engine stop valve, and thereby creating conditions which led to a very violent and destructive shock of water hammer. In this case the accumulation of water in the pipes is said to have been due to the steam trap having been shut off for some reason that cannot now be ascertained. Generally, there is nothing more reliable to avoid water hammer such as occurred in this case than the use of open-ended drains, visible to the operator, placed at carefully chosen parts of the pipe range. Such drains must, however, be used with care, and unless the pipes in the range are quite hot they should only be opened when the stop valves controlling the steam supply are so far shut down as to admit only sufficient steam to blow out the water of condensation and heat up the range. When the latter is fully heated and steam is issuing from the drains the boiler stop valves may be opened fully without risk of water hammer.

Miscellanea.

FOUR new 80ft. bascule bridges are to be built across the Welland Canal, at a cost of 500,000 dollars.

WORK is to be started very shortly on a refinery for treating the mica mined near Bancroft, Ontario.

IT is proposed to expend £1,000,000 within the next five years on afforestation in the Australian Commonwealth.

A MILL for the manufacture of artificial silk is to be erected at Kendal. The capital of the company is £1,000,000.

IT is proposed to erect a large factory for making artificial silk by the cellulose-acetate process at Drummondville, P.Q., Canada.

THE electric power plant of the Kandy Municipal Council, Ceylon, is being augmented by the addition of a 330 horse-power four-cylinder Ruston-Hornsby oil engine.

A DIRECTOR of the firm of Allen and Hanbury, London, recently paid a visit to Australia, with the object of investigating the possibilities of establishing a chemical factory there.

THE quantity of coal produced in Tasmania during 1924 was 75,988 tons. It was drawn mainly from the Cornwall and Mount Nicholas collieries in the St. Mary's district on the east coast.

A LARGE factory for the manufacture of the cheaper qualities of artificial silk is to be established in the Rhineland at Elberfeld. Half of the capital of 2,000,000 marks is being supplied by the English company of Courtaulds.

LARGE deposits of bauxite have been discovered between Bar and Ulcin, Montenegro. The deposits appear to resemble those found in Hungary, and are estimated at 30,000,000 tons. Negotiations are pending with French and German firms for working them on a large scale.

THE Canadian National Exhibition is having a number of new buildings added this year, one being for the Ontario Government. This building is triangular in shape, 490ft. frontage, and side walls of 360ft., and will cost 575,000 dollars. All the new buildings will be constructed entirely of Canadian material.

THE French coal industry has made great strides in the last two years, and is now producing more coal than before the war. In 1924 the output—44·95 million tons—was 6½ million tons more than in 1923, and for the first six months of 1925 was 23½ million tons, or at the rate of 47·49 million tons for the year.

THE number of blast-furnaces in operation in France, which stood at 125 on January 1st, 1924, was 133 a year later, and on June 1st and July 1st last it was 141. On the last date there were in all 220 furnaces in France, of which 68 were in Alsace-Lorraine, 85 in the Nancy or Eastern region, and 20 in the North of France.

ADDRESSING the Worcester local Ratepayers' Association on the subject of the city's finance, Sir Arthur Carlton mentioned the £47,000 electrical extension scheme. The speaker pointed out that the undertaking had paid off its £8000 debt to the rates, and that the charges for electricity both for power and lighting purposes were somewhere in the first eight of low charges in the country.

DURING 1925 there were over 200 launches of lifeboats round our coasts, and 380 lives were rescued from shipwreck, an average of over seven lives for each week of the year. Of these lives, 291 were rescued by the lifeboats, and the remaining 89 by shore boats and in other ways, the rescuers in every case being rewarded by the Royal National Lifeboat Institution for their gallantry.

A NEW organisation, known as the Institution of Fuel Economy Engineers, has just been formed, with the object of dealing in a scientific manner with the problem of preparing and utilising our fuel resources efficiently. At the recent inaugural meeting of the Institution the first Council was elected, and it was decided to form sections in different parts of the country. The ideal behind this new Institution is that it shall be the responsible organisation, representing every section of fuel technology throughout the country.

THE High Commissioner for Canada in London has received from the consulting engineer to the Hydro-electric Power Commission of Ontario, a library copy of the statement and engineering report prepared in 1921 by the Commission for submission to the International Joint Commission respecting a proposal to develop the St. Lawrence River water powers. This report, which has just been published, is an important contribution to technical literature on the subject of power generation along the St. Lawrence River, and it is thought that the arguments contained therein, as well as the estimates and accompanying plans, may be of interest to engineers in the United Kingdom. The report may be consulted by arrangement at the office of the High Commissioner for Canada, the Canadian Building, Trafalgar-square, S.W. 1.

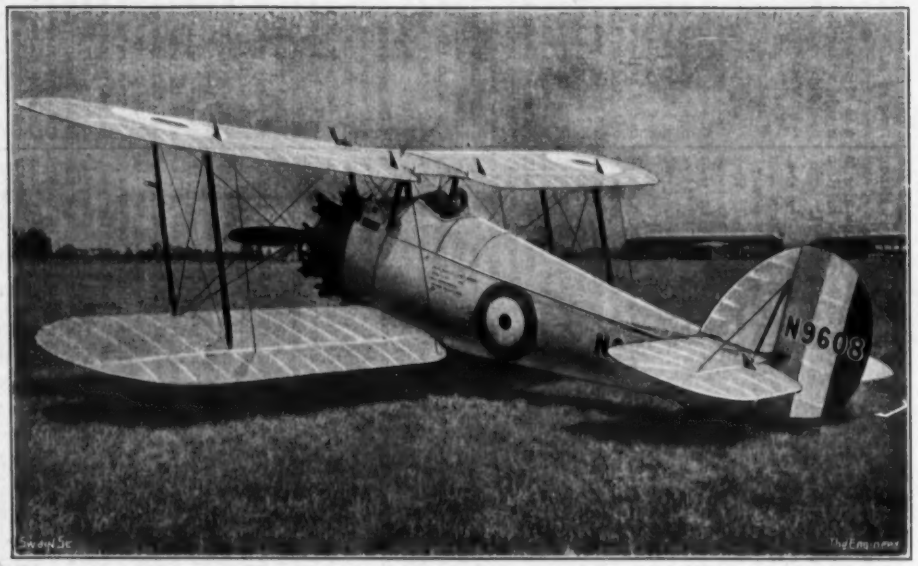
ACTIVE preparations are in progress for the development by the Whitney interests of New York of the Flin Flon copper property in Northern Manitoba, the extent of which is estimated at 16,000,000 tons of ore. The total expenditure involved is approximately 24,000,000 dollars, including the price of the property, which was recently taken over on option from the Mining Corporation of Canada. The plans of the purchasers are understood to include the erection of a smelter and mill at a cost of about 15,000,000 dollars, and a power development on the Churchill River to cost about 4,500,000 dollars. Some 3000 tons of material will be hauled from The Pas during the winter in preparation for construction work in the spring. This development will be of great importance, both to the mining and railway interests of Manitoba. The Canadian Pacific Railway will furnish transportation by an extension of the branch now terminating at Nipawin, Sask., 131 miles West of Flin Flon, but an extension of the Hudson Bay Railway and the construction of a branch line would provide a shorter route, and there is likely to be a keen competition between the companies for the traffic of the area, to which several other important mines in the neighbourhood will contribute.

SOME AEROPLANES OF 1925

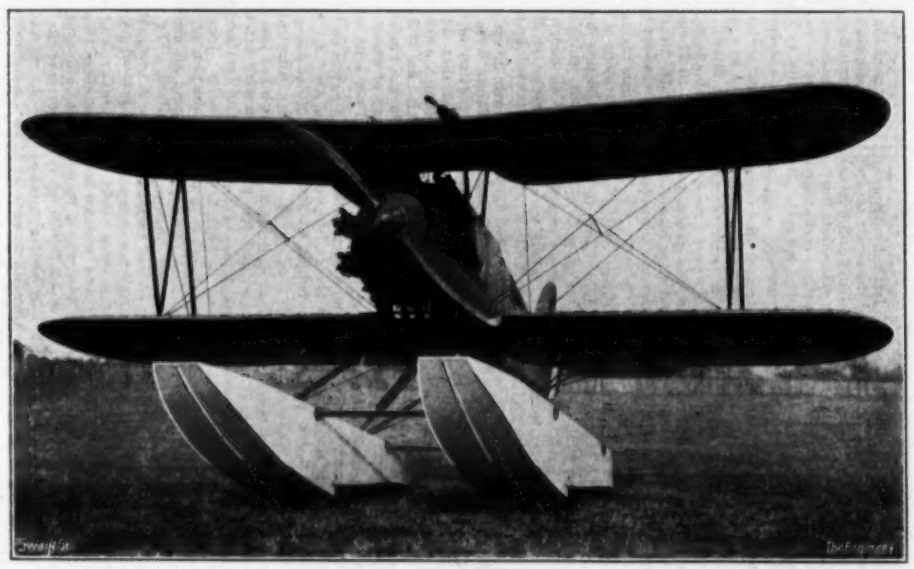
(For description see page 32)

ARMSTRONG-WHITWORTH "AJAX" RECONNAISSANCE BIPLANE

"GLOSTER III." RACING SEAPLANE



PARNALL "PLOVER" SINGLE-SEATER MACHINE



PARNALL "PLOVER" SINGLE-SEATER AMPHIBIAN

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 576, Cangallo.
CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris. CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. COMBRIDGE AND CO., Bombay; THACKER AND CO., Limited, Bombay; THACKER, SPINK AND CO., Calcutta.
ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umbarto 1, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
JAPAN.—MARUZEN CO., Tokyo and Yokohama.
AFRICA.—WM. DAWSON AND SONS, Limited, 7, Sea-street (Box 49), Capetown.
C. JUTA AND CO., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND CO., Gresham-street, Adelaide.
CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS CO., 386–388, St. James-street, Montreal.
TORONTO NEWS CO., 42, Yonge-street, Toronto.
CEYLON.—WIJAYARTNA AND CO., Colombo.
JAMAICA.—EDUCATIONAL SUPPLY CO., Kingston.
NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND CO., Auckland; J. WILSON CRAIG AND CO., Napier.
STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.
UNITED STATES OF AMERICA.—INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS CO., Chicago.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.	THICK PAPER COPIES.
Half-yearly .. .. £1 11s. 6d.	Half-yearly .. .. £1 12s. 0d.
Yearly .. .. £3 3s. 0d.	Yearly .. .. .. £3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition .. £3 3s. 0d. ,,

**** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d each, 5s. 3d. post free.*

ADVERTISEMENTS.

**** The Charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above are included in "THE ENGINEER Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

"THE METALLURGIST"—BOUND VOLUMES.

Cloth Binding Cases for twelve issues (one year) .. .. 2s. 0d.
Binding Subscribers' own copies, including cases—In cloth, 4s.; in half roan .. .. 7s. 6d.
Limited number of Bound Volumes of THE METALLURGIST are available, per volume 12s. 6d.; post free .. 13s. 0d.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, The Engineer *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, January 8th, 1926. PAGE

A SEVEN-DAY JOURNAL .. 31
AERONAUTICS IN 1925. No. II. (Illus.) .. 32
WATER SUPPLY IN 1925 .. 35
THE PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION. (Illus.) .. 37
LITERATURE .. 39
MOTOR GENERATORS FOR THE RUGBY WIRELESS STATION. (Illus.) 40
LETTERS TO THE EDITOR—
Empire Trade Expansion .. 42
The British Steam Locomotive, 1825 to 1924 .. 42
Road Corrugations .. 42
RAILWAY MATTERS .. 43
NOTES AND MEMORANDA .. 43
MISCELLANEA .. 43
LEADING ARTICLES—
Metallurgical Education .. 45
Sixty Years Ago and To-day .. 45
RAILWAYS IN 1925 .. 46
CANADIAN WATER RESOURCES .. 47
RECENT LINER PERFORMANCES .. 47
SKIP HOISTING AT COAL MINES .. 47
ELECTRICAL ENGINEERING IN 1925. No. II. (Illus.) .. 48
HARBOURS AND WATERWAYS IN 1925 .. 50
STEAM TURBINE PLANT FOR AN OLD COTTON MILL. (Illus.) .. 52
A NEW HYDRAULIC PUMP. (Illus.) .. 53
A LOCOMOTIVE FEED-WATER HEATER. (Illus.) .. 53
CALENDARS, DIARIES, &c. .. 53
VAN RYNEVELD'S PASS IRRIGATION WORKS .. 54
SIXTY YEARS AGO .. 54
EDUCATIONAL INTELLIGENCE .. 54
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 54
LAUNCHES AND TRIAL TRIPS .. 54
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 55
Lancashire .. 55
Sheffield .. 56
North of England .. 56
Scotland .. 57
Wales and Adjoining Counties .. 57
CONTRACTS .. 57
CURRENT PRICES FOR METALS AND FUELS .. 58
FRENCH ENGINEERING NOTES .. 59
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 59
FORTHCOMING ENGAGEMENTS .. 60
PARAGRAPHS—
Commercial Education—Junior Institution of Engineers—New Method of Measuring Pressures—The Motor Ship Primero—The "O.M.S." .. 54

DEATH.

ON December 29th, at 53, Bryn-road, Swansea, AUGUSTUS OSWALD SCHENK, M. Inst. C.E., A.M.I. Mech. E., for twenty-nine years Resident Engineer to the Swansea Harbour Trust in his seventy-seventh year.

THE ENGINEER.

JANUARY 8, 1926.

Metallurgical Education.

THE recent visit of M. Ronceray and his lecture in Birmingham on what is being done in France to secure the satisfactory education of foundrymen has attracted attention to that aspect of metallurgical education. While fully appreciating the importance of proper training in that direction, we would suggest that the methods and means adopted in the training of metallurgists for the higher branches of their profession or industry are also in need of critical consideration. On the one hand we hear that at the present time the young men who have graduated from our colleges, even after they have had one or two years of research experience, find it exceedingly difficult to obtain posts; on the other, that the entries of students for the full courses of study is falling off to a serious extent at most of our colleges. These two symptoms may, in reality, be cause and effect; they are also, doubtless, related to the prolonged industrial depression which has so profoundly affected our engineering and metallurgical industries. But we venture to suggest that there is a further underlying cause. If the graduates of our colleges were proving or had proved themselves supremely valuable and successful in the industry, even industrial depression could not destroy the demand for them. Unfortunately, actual inquiry in various branches of the industry gives ground for the fear that these men have not always proved as successful as their college record would lead one to anticipate. In the interests of the industry, of the colleges and of the men themselves, it is important to seek any possible clue to the cause of this partial lack of success.

The reasons that are usually given by the practical men of an industry in such cases are that the young graduates are "not practical enough" or "too academic," but such phrases in reality indicate little more than the fact that the practical men and the college-trained graduates do not understand one another. When a graduate first enters an industry, such lack of complete mutual understanding is not perhaps surprising, but if it persists after a few months of experience, it can only mean that the graduate, for some reason, has not been rightly trained for his job. The knowledge a young man has acquired can be of no use to him in industrial work unless he can apply it, and he has no prospect of securing such application unless he can bring himself into the closest sympathetic touch with the practical men—directors, managers, foremen, and workmen—in whose hands the application of his knowledge must rest. Only too often the young graduate makes no real effort to get into such touch and prefers to confine his work to the more familiar but greatly restricted sphere of the works laboratory, producing test or analytical figures without making the necessary effort to secure their understanding and intelligent application. He adopts an attitude of aloofness, and is, in return, regarded with—at best—good-humoured toleration; and that way lies failure, both for the individual and ultimately for the industry. Where does the fault lie? The ambitious young man who seeks a university training is not, inherently, lacking in interests or sympathy. Is it that his training tends to make him "superior" or aloof from the difficulties of practical life? It certainly should not and need not do so, and experience in other branches of industry serves to show that any defect of the kind can be entirely avoided. But how? The answer lies in securing for the college-trained man a wider outlook, both on the scientific and the practical side. On the scientific side we see in many of our colleges undue specialisation at the expense of adequate training in fundamentals; there is a tendency to teach the men to know too many things and not enough to make them think for themselves. By teaching too little general science and too much metallurgical detail, an effect is produced which is apt, in all but the very ablest men, to encourage the idea that they know a great deal about metallurgy, while in reality they have not sufficiently acquired the fundamental principles to enable them successfully to attack problems outside their text-books. The best cure for such an attitude of mind is, of course, contact with industrial practice, where possible, by direct experience in a works before the titulary dignity of a university degree makes them feel that they should be teaching rather than learning. Failing this, however, and even in addition to it, contact with practical life is necessary through the minds of the teachers. It is in this respect that perhaps some of our colleges are most open to criticism. In many cases the training of our professors has been almost entirely academic, passing from studentship through a post as demonstrator or lecturer to a professorship. In only a few rare instances have any of our metallurgical professors held active industrial posts, even for a short term of years. While we are second to none in our appreciation of their ability, their enthusiasms and their industry, these things cannot alter their outlook nor enable them to convey to their students that sympathy for and understanding of the difficulties of practical industrial life which is essential to success in that career. It is by no means easy to suggest an immediate remedy. The consultative activities of some of our professors are all to the good in this connection, but the outlook of the consultant is still widely different from that of the man in daily and hourly contact with the human as well as the technical problems of industry. Ultimately, if our universities could be persuaded that academic experience is not the only or even the main qualification for a professorship, men with some practical experience as well as scientific knowledge might find their way into our metallurgical chairs. At present the aspirant to professorial honours must seek a series of minor academic posts rather than a widening experience outside.

Meanwhile, the best that can be done is to give the student the opportunity to acquire a wider outlook for himself through a period of pupilage in a works, before he receives a qualifying degree; but a "vacation course" of a few weeks, although better than nothing, is still quite inadequate. He must be given time enough to get to know men and conditions of a kind widely different from those of his college. Then, perhaps, when he returns to industry after the completion of his college training, he will be able to bridge the gap between his scientific knowledge and the troubles of the practical man—able to realise the difficulties and limitations of both, and meet them in a human and not merely in an academic way.

Sixty Years Ago and To-day.

IN the daily papers of Wednesday there appeared a statement which must have been read with interest and varying emotions by many engineers. It informed the public that henceforth the London and North-Eastern Railway Company would insist on all the steel used on its contracts being British in origin and manufacture, and it added that the three other railway groups already enforced the same conditions. We can hardly suppose

that the London and North-Eastern Railway has been cajolled by the admonition to "Buy British Goods," which has been addressed to the young ladies and gentlemen who open its vast correspondence. Nor do we suppose that its action is entirely disinterested. The railway companies, and particularly those which run into the Midlands and the North, have very great business relations with the steel firms, and the usual exchange of business courtesies would tend, at least, to draw them towards the course which has been indicated. We do not suppose, either, that any political feeling has moved the railways to this action, but we may justly credit them with a desire to serve their country, at the same time that they serve themselves, by encouraging one of its greatest industries. This we expect from the railways. They are from their nature and from the powers which are conferred upon them by the State more national than any other industry, and it is right that they should take, as we are proud to say they do take, a national view of their responsibilities. Their success, it is true, depends upon the state of the trade of the country, and they are not worried by such vexed considerations as have to be weighed by the shipbuilder who uses plates rolled from cheap foreign billets. Yet we have seen not a few other instances of bodies not so very different from railway companies taking a narrower view and saving a few thousand pounds of immediate money with little or no regard to the future of British industries.

This statement with regard to railway contracts comes very appropriately at the beginning of a year which, by general agreement, should prove to be the turning point in our fortunes. The country is, we are convinced, so near success that it needs now no more than a firm resolution to succeed to make recovery certain. We spoke only last week of reliance upon ourselves, but we welcome this opportunity to urge once again the people of this country to recover the confidence in themselves which added strength to their purpose and led them from triumph to triumph in Victorian days. The firm belief in British engineering, which was then held by Britons, had its reflection in other lands. The world joined with us in the belief, supported by solid facts, that we were a nation of engineers. Then confidence reacted upon us, and what we believed ourselves to be we became. It was when we began to regard our preeminence with suspicion, when we began to think other nations might be even better than we were, that we lost some of our hold. When we ceased to give to our own countrymen that encouragement which was their due, and preferred rather to rely upon foreign engineers, we developed a weakness from which it is hard to recover. For ourselves we do not doubt the ability of British engineers to have produced every one of the machines and processes which in the last thirty or forty years have been imported. But belief and encouragement were too often lacking, and there was too often a hesitation about making experiments and venturing money on new inventions. We waited until other nations had secured the position, and then took licences from them. We pray that such diffidence may pass; that in the coming years we may see again that almost arrogant belief in ourselves which, however much it may be contemned, does actually make for greatness, and that once again Great Britain may hold the proud position of the greatest and most adventurous engineering country in the world.

In this connection a comparison of the state of the country's industries to-day with that at the opening of 1866 is not without its value. Reviewing the situation in our issue of January 5th, 1866, we wrote that "the commercial prosperity of the people of this happy land has grown and strengthened until it has become beyond all comparison rich." Gold was lying idle in our coffers. Our little islands had grown all too small for the aspirations of their inhabitants, and the ends of the earth were sought as fields for new investments of capital. Other nations gladly purchased the goods which British gold, skill and energy could alone provide. Unparalleled sums were being expended on engineering operations. Nearly four hundred Bills for the construction of railways awaited the attention of Parliament during its next session. Our locomotive and carriage building establishments were so full of orders that British railway companies had been compelled to procure engines from the Continent. At home or abroad the engineering profession, as a whole, had never played a more important part, and had never received higher reward for the services it rendered. The picture thus presented in brief outline is a glowing one and might well inspire thoughts of regretful envy. But we may take comfort from the knowledge that the prosperity of 1866 succeeded a period of depression, bearing close resemblance to that which we have been passing through during recent years. In 1856 the embers of the Crimean War had barely been quenched. The Continent was distracted by internal commotions and afforded the worst possible field for speculative investment. Our national treasury was well-nigh drained, and our heavily taxed people were uncertain as to what the future might bring about for evil or for good. Enterprise slumbered, distress prevailed in the manufacturing centres, and there was an absence of money, a feeling of uncertainty and a lack of confidence in all quarters. Yet within ten years time a flood of commercial prosperity swept over the country. If history repeats itself as it is said to do, we may well take cheer in turning our eyes backwards towards our past state and achievements.

Railways in 1925.

By the continued kindness of the respective chief engineers of the various railways we have been furnished with reports as to the progress of the more important undertakings on their lines in the past year.

London, Midland and Scottish.

The line of the former London and North-Western system for Liverpool, *vid* Runcorn, leaves the main line to the North at Weaver Junction, 16 miles north of Crewe. The widening of this length to take four lines of way was sanctioned in 1900. The work divided itself naturally into four portions and the first—between Crewe and Coppenhall Junction—was completed in 1908. Parts two and three have now been put in hand and consist of an extension of the Crewe–Coppenhall Junction widening to a point just short of Winsford Station, and from Hartford Junction to Acton Bridge Station, the latter point being 1¼ miles south of Weaver Junction and the viaduct over the river Weaver. The remaining 5¼ miles, between Winsford and Hartford Junction, together with the length Acton Bridge Station to Weaver Junction, present engineering difficulties, *e.g.*, two big viaducts, and will be undertaken later.

The main line station at Warrington is in course of enlargement so as to provide for four through running lines. The enlargement of that at Bangor is practically finished. The widening from two to four lines of way between Horbury and Wakefield is well in hand. A new station, to be known as Hillside, is being erected between Ainsdale and Birkdale on the Liverpool–Southport line. Further extensive additions are being made to the reception and marshalling sidings at Willesden, which involve a new bridge over the river Brent. The work necessitated in the increased siding accommodation at Ellesmere Port is nearing completion.

The tunnel at Morley, between Batley and Morley, is 3350 yards long and was constructed when the Huddersfield and Leeds Railway was built—nearly eighty years ago. About two-thirds of it have, from time to time, been relined and its structure gauge dimensions increased so as to accommodate modern rolling stock. About 870 yards at the Batley end remained to be relined and the work was taken in hand in September, 1920. It is making good progress, as 629 yards had been completed up to the end of the year. Another big tunnel, in which relining is being carried out, is the Mossgiel at Mauchline, on the Glasgow and South-Western section, 2052ft. long. A certain amount of work was done in 1924 and the length now in hand amounts to 955ft. The work is being carried out at three different points, and 620ft. have been completed. It is expected that it will be finished early next summer.

The Settle and Carlisle section of the former Midland Railway was opened for goods traffic fifty years ago. It is, as is well known, very exposed in many places, and the responsible officers have had very anxious times when storms or long periods of wet have occurred. The first two months of 1925 witnessed a rainfall that beat all previous records, whilst on New Year's Day, at Appleby, 1¾in. of rain fell. On December 28th, 1924, immediately south of Appleby, the embankment under the down line subsided for a distance of 600 yards and under the up line for 200 yards, whilst a retaining wall, over 100 yards in length, on the down side, failed. In replacing the latter three concrete counterforts were put in behind that portion of the wall which had fallen down. They are 14ft. long by 12ft. wide, going down to a depth of 7ft. 6in. below the level of the adjoining highway. The excavation was quite a difficult matter, as the depth was over 20ft. and provision had to be made, by means of six rectangular frames of timber, each consisting of six struts of 14in. by 14in. section, together with cross pieces, &c., to hold up the embankment. The embankments where the slips occurred are now strengthened by means of toe walls, made of dry masonry and varying in height from 3ft. to 9ft. and in thickness from 6ft. to 10ft. The work was completed in the summer.

About a quarter of a mile south of Long Marton, in the same vicinity, the rail level at Long Marton Viaduct is 50ft. or 60ft. above the river. The bridge is one of five stone arches, each having a span of about 45ft. On December 29th the embankment at each end under the down line subsided. Here, too, toe walls were constructed which are in places about 12ft. thick and 9ft. high. Between Culgaith, 7¼ miles north of Appleby, and Waste Bank Tunnel there was a slip on both sides of the line. On the up side is a cutting 80ft. high and on the down side an embankment leading down to the river Eden, 90ft. below. Three washouts occurred on the up side on December 28th and the embankment on the down side slightly subsided. The upper portion of the cutting was subsequently lightened.

The Victoria Station, Manchester, of the Manchester and Leeds Railway, which in 1847 became the Lancashire and Yorkshire Railway, was opened on January 1st, 1844, and in the following May the Liverpool and Manchester, a constituent of the London and North-Western on its formation in 1846, ran into the western end of the same station. Later the latter company built its Exchange Station on the western side of the river Irwell, but retained its former portion of the Victoria Station for fish traffic. In a sense the two stations are continuous, but now they are to be definitely joined by making No. 11 platform in Victoria and No. 3 in Exchange into one platform. The latter is further to be extended in a westwardly direction. The total length of the platform face will then be 733 yards in length, and thus it will be one of the longest platforms in the world. The large span roof over the L. and N.W. station has already been removed and a new one is in course of construction. An additional through line is to be laid in and crossover junctions will be provided so as to allow for the quick transfer of trains between the various roads. The removal of the L. and N.W. station wall on the north side will allow the signalling to be concentrated in one power-worked signal-box and Victoria West Junction and Irwell Bridge boxes in the L. and Y. station and Exchange No. 3 in the L. and N.W. station will be dispensed with. The signalling system will be the "all-electric," and it is intended that it shall embody all the latest safety appliances. Additional bridging over the river Irwell will be required for the joining up of the two stations, and for the new cab approach to an additional booking-office which is to be erected between the two stations.

The two lines of way on the former Midland section between Chevet Junction and Snydale Junction, a distance of 3¾ miles, are to be increased to four. The scheme consists of two parts and the contract for one was let first and is in hand. It covers the widening of the 1¼ miles between Chevet Junction and Sandal and Walton Station, in which section is the Chevet Tunnel, 702 yards in length and 95ft. deep. Coal workings underlie the tunnel, and it became necessary to consider whether the coal under and near the line should be purchased in order to protect both the existing tunnel and a second one that would have to be built for the widening, or whether the tunnel should be removed and all four lines be run in open cutting. The latter course was adopted and the work of removing the tunnel has now been completed. A commencement has been made with the northernmost portion of the widening for a length of about 2½ miles, involving the removal of about 100,000 cubic yards of excavation and the widening of nine bridges. Another widening on the Midland system is on the Birmingham and Gloucester line and extends from Halesowen Junction, 8 miles from New-street Station, Birmingham, to Barnt Green—the junction station for the Redditch branch—a distance of 2¾ miles. Here, also, a tunnel—the Cofton, 440 yards in length and 80ft. deep—has to be opened out. Some five or six bridges have to be widened and nearly half a million cubic yards of excavation must be removed. A contract for this work has just been let.

London and North-Eastern.

On the Southern area—the Great Northern, Great Eastern and Great Central sections—of the London and North-Eastern Railway the short line to the Thoresby Colliery in the Dukeries and the Woodburn Junction and Darnall Widening approach completion. The provision of additional loops and the extension of the marshalling yard at Woodhouse Junction are well in hand. At Dewsnap accommodation for 1272 more wagons has been provided. The new branch, about 6 miles in length, from the South Yorkshire Joint Line to Firbeck Colliery will be finished during the coming summer. The replacement of the old timber pier at New Holland, referred to in the last three annual reviews, was completed during the year and a contract was let for the remaining portion of the approach to the pier head. Contracts were also let for a new station at Welwyn Garden City and for one at Brooksman Park, between Potters Bar and Hatfield.

Of some historical interest is the replacement of the two original swing bridges at Beccles and St. Olaves, on the Ipswich and Yarmouth line, which was opened in 1854. In both cases double-track bridges replace structures with only one line. The new bridge at Beccles is 446ft. in length between the abutments and

has seven spans. The pivot portion has a swing pier 30ft. in diameter and gives two openings of 48ft. each. All six piers are of brick and concrete and the superstructure is of steel. The St. Olaves bridge is 530ft. long between the abutments, has nine spans, the pivot pier is 30ft. diameter and the openings each 65ft. It, too, has brick and concrete piers and a steel superstructure. In both bridges the girders are now being erected.

In the North-Eastern area the rearrangement and extension of the siding accommodation in the up goods yard at Heaton and the provision of additional goods lines at Newport and Erimus yards was continued. Progress was made with the replacement of the timber viaduct of forty-three 25ft. spans at North Seaton by a steel viaduct of eleven spans of 75ft., two of 68ft., and one span of 80ft. 9in. The work of substituting an embankment for the wooden viaduct at Sleekburn was continued during the year.

In the Southern Scottish area—the former North British—the following works, mentioned in previous annual reviews, were completed during the year:—The reconstruction of the damaged portion of the fairway wall at Methil; the colliery branch at Seafield, near Kirkcaldy; the sprinkler installations for fire prevention at the Glasgow, High-street, goods warehouse and in the Cowlairs workshops. The work of reconstructing Berwick Station was, owing to circumstances beyond the company's control, delayed, but will, it is expected, be completed early in the present year.

Among the works in hand at the L. and N.E.R. docks in the North-Eastern area and on the former Great Central section are new dock gates at Tyne Dock, which will be completed in a few months. New gates are being provided at certain of the docks in Hull. Additional siding accommodation for timber traffic is being laid in at Hull and will be finished early in the present year. Alterations are being made in, and additions to, the plant at the hydraulic and electric power stations at Hull and Immingham.

Great Western.

The renewal of the roof of the goods shed at Paddington goods station and the rearrangement of the yard to meet modern requirements were in hand during the year. The first section of the work is well advanced. A new goods depôt, fully equipped, was opened at Ashley Hill, Bristol. It has been provided to meet local developments and relieve the congestion experienced at other neighbouring depôts. The existing goods station at Bristol, Temple Mead, is being reconstructed and enlarged. Good progress was made with this station, which, when finished, will cover an area of 6 acres, in which there will be nearly 2 miles of platform. Loops have been provided between Huish and Yatton and between Yatton and Claverham, to relieve the traffic between Bristol and the junction at Worle for the Weston-super-Mare branch. The extension of the platforms, laying in of new and altered connections and the building of retaining walls for the enlarged station at Newton Abbot made good progress. The station will have two island platforms and a bay on the up side at the east end for the Moretonhampstead branch. The contract is about to be let for the station buildings, and it is hoped that the work will be completed in time for next summer's traffic. The replacement of Penwithers timber viaduct by an embankment, which will require about 250,000 cubic yards of filling, and the substitution of a masonry viaduct to replace the timber structure at Perran—both on the Falmouth branch and the last of those in Cornwall constructed by Brunel—are proceeding. The Newquay branch was extended to Chacewater.

At Newport the subway between the down platform and the up island platform and to the new up-platform to be provided, in connection with the reconstruction of the station made progress. The greater proportion of the new carriage sidings at Ebbw Junction were laid in and a contract for the carriage shed there is about to be let. To allow trains on the Rhymney section to use the Queen-street Station, Cardiff, the number of passenger lines and the passenger accommodation at that place are being increased. The work is well advanced. The great changes to be made at the Swansea, High-street, Station were described in our annual article a year ago. A considerable amount of work was done thereon during the year, and it is hoped to start on the station buildings very shortly.

The Oxley and Kingswinsford new line, 9½ miles in length, and the doubling of the Kingswinsford branch were completed during the year. The reconstruction of Aberystwyth Station was finished and the Vale of Rheidol Light Railway from Devil's Bridge was diverted so as to run into the main line station and allow the Vale of Rheidol Station in Aberystwyth to be closed. Important sea protective works were carried out at Afonwen which involved 125 lineal yards of new sea wall being built. The headings of the new second single-line tunnel, 1605 yards long, at Colwall were joined up a few months ago and 1400 lineal yards of the lining were completed. A portion of Marlborough Tunnel was relined.

Works at the docks during the year included the adaptation, construction, and reconstruction of hoists and tips in connection with the use of 20-ton wagons for shipment of coal, whilst provision of storage sidings for shipment of coal was made at Cardiff and Newport. At King's Dock, Swansea, new lock gates have been provided and a slipway was constructed on which the old gates are housed for emergency purposes. At Port Talbot Dock a ferro-concrete ore wharf 875ft. in length was completed for Baldwins, Ltd., and brought into use. At Chelsea Creek 826 lineal feet of timber piling were replaced in ferro-concrete.

Southern.

On April 1st the electrical services on the Brighton section were extended to Croydon and Coulsdon and from Croydon to Sutton. On July 12th those on the South-Western section were extended from Claygate to Guildford, from Raynes Park to Dorking, and from Leatherhead to Effingham Junction. On the latter date the first stage in the electrification of the South-Eastern section was opened—from Victoria and St. Paul's to Orpington and to the Crystal Palace. It had been intended to bring into use on December 1st the section from Charing Cross and Cannon-street to Orpington *vid* Chislehurst, from Grove Park to Bromley North, and from Lewisham to Addiscombe-road. An official statement issued by the railway company at the beginning of November stated that the electricity supply contractors had, however, said that they could not be ready on December 1st. It is now hoped to open the service on February 1st. Considerable changes have been and are being made in the permanent way connections at sundry places on all three systems to provide increased facilities.

The Totton, Hythe and Fawley Light Railway was completed in July. Good progress was made with the enlarged station at Exmouth and with the increased locomotive accommodation at Exmouth Junction. A commencement was made upon the useful scheme for combining in one new station the accommodation provided by the existing Ramsgate Town and Ramsgate Harbour stations and to join up the Kent Coast line of the old Chatham and Dover line to the Ashford–Ramsgate branch of the former South-Eastern. That work involves the building of a new railway 1½ mile in length. Considerable improvements are being made in the railway and steamer accommodation at Ryde Pier.

Metropolitan and Great Central Joint Railway.

The burrowing junction just north of Harrow to segregate the Uxbridge branch trains from those on the main line was completed in September. The new line from a point between Sandy Lodge and Rickmansworth to Watford and a northern curve to give communication from and to Rickmansworth were opened on October 31st. Aylesbury station is being reconstructed and the work approaches completion.

Metropolitan.

The new junction near Euston-square that will join the main line to the Widened Lines from King's Cross to Moorgate, together with the conversion of the latter lines for electric traction and additional platform accommodation at Moorgate, will be completed in February. The Edgware-road Station is being rebuilt. The new accommodation will include two island platforms and have four through roads.

London Electric Railways.

Progress with the extension of the Hampstead line from Charing Cross, under the river, to Waterloo and Kennington awaits the possession of the station on the loop at Charing Cross by the engineers. It is intended to give it up on January 23rd, on which date the loop will be closed and the southbound line to Waterloo carried through, whilst the northbound line from Waterloo will join the loop further west and just short of the northbound platform at Charing Cross. The work undertaken from the shaft at Waterloo—which includes the under-the-river section—was completed up to the south side of the loop at Charing Cross in the one direction and joined the section under construction from the shaft in Bethlem Hospital grounds in the other direction. The stations at Waterloo are completed. Of the work thence to Kennington all is completed except about 400ft. in the southbound line. The stations at Kennington are finished.

The tunnels on the Morden extension of the City Railway from Clapham Common are completed; the track is being laid and the stations was under construction. It is expected that the line will be opened next summer.

Two Light Railways.

On April 7th the pretty inland health resort of Ashover in Derbyshire was given passenger communication by a light railway, 7 miles long and on a 2ft. gauge, from Clay Cross. The Torrington and Halwill Junction Light Railway was opened on July 27th.

CANADIAN WATER RESOURCES.

THE Dominion Water Power and Reclamation Service of the Interior of Canada has published a new volume of that portion of the series of water resources papers which deals with the surface water supply of Canada. This report is No. 45 of the series, and gives details of stream measurements made in the provinces of New Brunswick, Nova Scotia and Prince Edward Island during the climatic years from October 1st, 1922, to September 30th, 1924. It should be explained that the Dominion Water Power and Reclamation Service of the Department of the Interior is engaged in making a systematic survey of the water resources of the whole of the Dominion. For convenience in the administration of a survey covering so great an area, the country is divided into four major districts, the boundaries of which are arranged to correspond so far as possible with the watersheds dividing the great river systems of the northern part of the continent, but which must necessarily to some extent be governed by provincial and territorial boundaries. A separate series of stream measurement reports is published for each of these four divisions, and these cover respectively the Atlantic drainage south of St. Lawrence River, including Nova Scotia, New Brunswick, Prince Edward Island, and South-Eastern Quebec; the St. Lawrence and Southern Hudson Bay drainage in Ontario and Quebec; the Arctic and Western Hudson Bay drainage (and Mississippi drainage in Canada) in Alberta, Saskatchewan, Manitoba, extreme Western Ontario, and North-West Territories; and the Pacific drainage in British Columbia and the Yukon Territory.

The present report is one of the first series above described. It contains a short explanation of the purpose and scope of the work, and ninety pages of tables and descriptions of gauging stations, with an index map of the Maritime Provinces. This report will be supplied free of charge on application to the High Commissioner for Canada, Canadian Building, Trafalgar-square, London, S.W. 1, or to the Director, Water Power and Reclamation Service, Ottawa, Canada.

RECENT LINER PERFORMANCES.

THE maiden voyage of the motor liner Gripsholm, which was built by Sir W. G. Armstrong, Whitworth and Co., Ltd., for the Swedish-American Line, was, according to the accounts we have received, a most successful one. On her outward voyage, from Gothenburg to New York, the engines developed 15,740 mean indicated horse-power, with 16,150 as a maximum. The total fuel oil consumption of the main engines was 420·8 tons, which works out at 47·2 tons per twenty-four hours. If the oil consumed by the auxiliary engines, boilers and galley be added, the total was 577·2 tons, representing a daily average of 64·75 tons of fuel. We are informed that the main engines used 0·279 lb. per indicated horse-power hour. With a western swell the average speed of the ship over a measured distance was 16·05 knots, but 17·3 knots was the average throughout twenty-four hours of fine weather. On the return journey slightly increased horse-powers were developed, with a corresponding improvement in the vessel's speed, and with almost the same fuel consumption. Throughout the two runs the vessel, it is stated, showed excellent sea-going qualities in the rough seas and heavy swells which were encountered. The guaranteed mean effective pressures and horse-powers were, it is reported, maintained at a fuel consumption which the engine makers, Burmeister and Wain, of Copenhagen, inform us was about 20 per cent. lower than was expected.

In reviewing the progress made in marine engineering during 1925, we referred in our last issue to the success of the large installations of twin-screw double-reduction geared turbines built and fitted to the passenger liner Conte Biancamano, of the Lloyd Sabaudo Company, by William Beardmore and Co., Ltd., of Dalmuir. It is with considerable interest that we learn of the fine performance of this ship on her recent home voyage from New York to Genoa.

The average shaft horse-power for the complete voyage was 24,100, and the average speed to Naples was 20 knots. From Naples to Genoa the speed was increased to 21·29 knots average. The report received was that the machinery worked perfectly, and that the economy was even better than during the official trials. It is understood that the owners are so pleased with the performance of this machinery that it is anticipated that, in a new vessel projected, the shaft horse-power will be considerably increased, and the same design of turbines and double-reduction gearing as fitted in the three big previous ships—and described and illustrated in our issue of November 20th last—will be adopted.

SKIP HOISTING AT COAL MINES.

A STUDY of the comparative merits of cage hoisting and skip hoisting at coal mines in Illinois indicates material advantages for the latter and newer method, especially if properly used to facilitate the development of these advantages. Six principal advantages cited are:—(1) Greater capacity for a given size of shaft; a skip can have a horizontal cross-section equal to that of a cage and a depth for any desired capacity, the minimum being two wagon loads. (2) Easy increase in hoisting capacity by lengthening the skip. (3) Lower cost of power, since skips, in comparison with cages, give a higher ratio of coal load to dead load, and more nearly balanced dead loads. With high hoisting speeds and acceleration rates, the cost of power per ton of coal will be greater than with slower speeds, but that will be balanced by other economies. (4) Lower labour cost per ton, both in bottom and top activities, but this cost is not a heavy item with either system. (5) Use of solid-ended mine wagons, handled in rotary dumpers, thus reducing the cost of wagon maintenance and the spilling of coal and dust at end gates. (6) Reliability in dumping the coal. On the other hand, disadvantages claimed include:—(1) Greater first cost and maintenance; there is not sufficient evidence to prove this. (2) Greater breakage of coal; this exists in practice, but can be avoided by proper methods. (3) Complication in handling men and materials, but most large mines, with either skip or cage, have a separate shaft for this service. (4) Difficulty of inspection and of tracing bad work to the individual miners; this may be overcome by underground inspection of the mine wagons. (5) More dust, due to dumping; but this trouble can easily be avoided.

Electrical Engineering in 1925.

No. II.*

Transformers.

One of the most noteworthy achievements in the transformer business was the design and construction of testing transformers by Ferranti, Ltd., for the production of a sustained arc at a pressure of a million volts, as described in our issue of April 10th. The arc, which was maintained between points 114in. apart, is shown in Fig. 6. For the production of this arc three 333,000-volt transformers were connected in cascade. As the result of data obtained during the million-volt test the company has been able to introduce distinct improvements in the design of small-pole type transformers, and it is now possible to produce these transformers for voltages considerably higher than those which were considered desirable in the past. The company has experienced a considerable demand for this class of transformer, which has been supplied mainly to places abroad. There is little doubt, however, that in due course there will be a very appreciable demand for transformers of this nature in this country. Another undertaking of importance was the completion by Ferranti, Ltd., of the first 30,000-kilovolt-ampère bank of transformers for the Tata Power Company, Ltd., of India.

A group of transformers was supplied by the Metropolitan-Vickers Electrical Company for the 132,000-volt transmission line between the Witbank and Brakpan stations of the Victoria Falls Power Company

FIG. 6—A SUSTAINED ARC BETWEEN POINTS 114in. APART—FERRANTI

of South Africa. It is claimed that these transformers represent a departure from usual British practice on account of the voltage for which they have been designed and also on account of their size. Each single-phase unit is rated at 11,000-kilovolt-ampères and with the tank and oil weighs 50 tons. For the Shropshire, Worcestershire and Staffordshire Electric Power Company this firm constructed six single-phase, 7500-kilovolt-ampère transformers with a ratio of 5500/33,000 volts and six 10,000-kilovolt-ampère, 6600/33,000-volt three-phase transformers for the Liverpool Corporation, twelve 4000 kilovolt-ampere, 11,500/6600-volt single-phase transformers for the Newcastle-on-Tyne Electric Supply Company, and transformers with an aggregate capacity of 84,000 kilovolt-ampères for the County of London Electric Supply Company. Transformers for pressures of 110,000 and 33,000 volts and with an aggregate capacity of over 50,000 kilovolt-ampères were built by the Metropolitan-Vickers Electrical Company for abroad. Important contracts were received for outdoor transformers and small capacity distribution transformers for pole mounting.

The most noteworthy transformers built by the English Electric Company are for service in India. Each transformer has a continuous output of 12,500 kilovolt-ampères on a 110,000-volt three-phase, 50-cycle system. Three single-phase transformers are connected in banks having an output of 37,500 kilovolt-ampères. They are core type transformers, and an interesting feature is the provision of an oil duct in the middle of the core. The Liverpool Corporation placed an order with the English Electric Company for seven single-phase, 33,000/6000-volt shell type transformers, each rated at 3333 kilovolt-ampères, and three of these transformers are connected to form a 10,000-kilowatt three-phase bank. Orders were placed with the company by the Preston and Blackburn Corporations for transformers similar to those supplied to Liverpool, with the exception that they are to form banks of 8700 kilovolt-ampères capacity. These transformers are being installed in an outdoor sub-station, manufactured by the English Electric Company, which finds that there is a growing tendency to erect sub-stations of this nature.

During the year the British Thomson-Houston Company increased its transformer manufacturing facilities, and orders were received for transformers of large and small capacities. Among the most important orders of this nature carried out by Johnson and Phillips were for four 6200 kilovolt-ampère, three-phase transformers for the Sydney Municipal Council; a three-phase forced cooled transformer for the Newcastle, N.S.W., City Council; a large number of medium-sized transformers for the Lloyd barrage works at Sukkur, India; and for the Durban Municipality. Nineteen 3000 kilovolt-ampère single-phase transformers are at present in hand for the Victoria State Electricity Commission. In the shops of the General Electric Company transformers were built for the Clyde Valley Electric Power Company and the Rotherham, Keighley, Glasgow, Todmorden, Doncaster, Edinburgh, and West Bromwich Corporations, &c. The British Electric Transformer Company reports that the outstanding feature of the year, as regards export trade, was the construction of four 500 kilovolt-ampère, single-phase, 50,000-volt, self-cooled transformers and seven 1500 kilovolt-ampère, single-phase, 110,000-volt transformers of the same type for the New Zealand Public Works Department. Three 5000 kilovolt-ampère, three-phase, 33,000-volt, self-cooled transformers were also supplied to the Sydney Town Council. Linking up schemes in this country resulted in a very large demand for Berry regulating transformers and switchgear. The aggregate feeder capacity of the actual mains controlled by Berry regulating mechanism supplied or ordered during 1925 amounted to no less than 131,500 kilowatts.

Hydro-Electric Plant.

The English Electric Company was engaged upon the manufacture of the five 30,000 horse-power impulse turbines for the Tata Power Company, referred to in our last annual review. The manufacture of the generators to be driven by these turbines is now being carried out. The continuous rating of each of these machines is 26,000 kilovolt-ampères at a pressure of 12,000 volts and a speed of 375 revolutions per minute. Water turbines, generators and the complete electrical equipment for the hydro power stations on the river Clyde are being built by the English Electric Company. The weirs, tunnels, pipe lines, buildings and bridges are being constructed by Sir William Arrol and Co., who are working in conjunction with the English Electric Company. In the Bonnington station there will be two vertical, reaction, 7000 horse-power turbines, each driving a 25-cycle generator, giving 11,000 volts at a speed of 375 revolutions per minute. At the Stonebyres station there will be two similar turbines rated at 4000 horse-power. The stations will be connected by overhead transmission lines to the supply system of the Clyde Valley Power Company. The English Electric Company also has in hand a 12,000 horse-power vertical turbine and generator for abroad. With all the above plants "Seewer" type cylindrical valves will be supplied, the advantages of which are well known. Two generators for coupling to water turbines were built by this firm for the Dolgarrog station of the British Aluminium Corporation, Ltd., each having a capacity of 6250 kilovolt-ampères at a pressure of 6600 volts. As the result of the recent dam accident these machines were partially submerged, but they were quickly dried out and put into service. Three other generators for the same Corporation are now under construction. Five generators, each rated at 625 kilovolt-ampères and designed to run at a speed of 750 revolutions per minute, were manufactured for a mining plant abroad, the contract including the supply of switchgear, transformers, overhead transmission lines, sub-station plant, &c.

Electric Motors.

The demand for alternating-current motors that will work at a high power factor is now considerable, and firms that manufacture these machines are experiencing good business. Many large auto-synchronous motors, which possess the valuable property of running without drawing a lagging current from the supply system, were supplied by Crompton and Co., Ltd. For an oil pumping installation in Burma this firm supplied twelve auto-synchronous 75 brake horse-power motors, running at a speed of 580 revolutions per minute. Motors of this type have been applied to practically every class of industrial service, and in some cases the starting torque required is as much as three times that of normal full load. An order for a salient pole self-starting synchronous motor, rated at 1280 horse-power, for driving a Belliss and Morcom air compressor at the Bolsover Colliery, was secured by the British Thomson-Houston Company. This firm placed a "no-lag" induction motor on the market, designed to run at unity or a leading power factor. The demand for direct-current motors was found by the company to be high, but the largest individual orders were for alternating-current motors. A 350 horse-power, 6500-volt, induction motor, with high-tension stator contactors and a rotor contactor control panel for driving pumps for de-watering dry docks at Princes Dock, Glasgow, was one of the most noteworthy electric motor orders secured by the British Thomson-Houston Company. Large alternating-current motors for haulage, mine ventilation, and for use in steel works, &c., were supplied by Mather and Platt. The General Electric Company reports that it received many orders for motors for use in mines, steel works, shipbuilding yards, &c., and the company is dispatching machines for use on the Roumanian oilfields and for use in connection with the erection of the Sydney Harbour Bridge.

The Metropolitan-Vickers Electrical Company developed a new squirrel-cage induction motor, which gives an increased starting torque, with the normal running current, without a detrimental effect on the efficiency. With a starting current of 1.7 times the full load current, the machine gives 70 per cent. full-load torque, as compared with the 40 per cent. full-load torque obtained with ordinary squirrel-cage motors under the same conditions. Another advantage of the machine is that in many cases a star-delta starter can be used instead of an auto-transformer. A number of induction motors designed for three-speed operation were supplied by the Metropolitan-Vickers Electrical Company to the Liverpool Corporation for driving boiler-house fans. Over 300 motors, with an aggregate capacity of 3513 horse-power, were supplied by Bruce Peebles and Co., Ltd., to a cotton mill in Brazil, and two 600-kilowatt synchronous motor generator sets to the city of Santos, Brazil. Among many other motors built by Bruce Peebles and Co., Ltd., were two of 1200 horse-power and two of 600 horse-power for cement works in Australia.

Switchgear.

It must suffice to call attention to one or two of the main switchgear contracts undertaken by the large electrical firms. The British Thomson-Houston Company is dealing with an order for 110,000-volt switchgear for the hydro-electric power stations at Kalyan, India, and orders for totally enclosed ironclad heavy current equipments for Bloemfontein, South Africa. An appreciable demand was experienced by this company for 1500-volt direct-current traction switchgear. B.T.H. switchgear was supplied to the Southern Railway, the new Stourport and the North Wilford power station at Nottingham. An order was received for switchgear for five 33,000-volt outdoor sub-stations for the North Metropolitan Electric Supply Company. The Metropolitan Electric Supply Company is equipping six sub-stations with B.T.H. 20,000-volt and 6600-volt. switchgear. The foregoing are, however, only a few of the principal orders which the company has in hand. Many local authorities and other bodies are being supplied with switchgear made by this firm.

Good business was done in switchgear by the General Electric Company, the individual orders being too numerous to mention. An interesting truck switchboard, consisting of fifteen large truck cubicles for use on a 2200-volt single-phase 100-cycle system,

* No. I. appeared January 1st.

is being exported to Malta. Again, in the case of the English Electric Company, the contracts secured are too numerous to be referred to in detail. Seven sub-stations on the Southern Railway were equipped with 11,000-volt, 25-cycle, three-phase gear and 660-volt direct-current gear. Sub-station switchgear work was also carried out for Staines, Sunbury and Ascot, for a 20,000-volt bulk supply with distribution at 6600 volts and 2200 volts. Ealing will also take a bulk supply at 20,000 volts, and about fifty English Electric distribution feeder equipments were supplied. Outdoor sub-stations for the Preston–Blackburn linking-up schemes were equipped with this company's gear. A good deal of work was undertaken for abroad. For a large generating station in Russia a complete switchgear equipment was supplied for operating at 38,000 volts, an interesting feature of the scheme being the provision of a system of melting ice on the transmission lines by means of wattless current. For Poland a large amount of switchgear was made, including over twenty oil circuit breaker equipments for 35,000 volts and truck type gear for 6600 volts. For traction work, the English Electric Company developed a special magnetic high-speed circuit breaker, which, besides being very rapid in action, automatically adjusts its speed of opening in accordance with the severity of the short circuit. Several of these circuit breakers have already been supplied to Japan, and some are on order for South Africa. For 3000-volt traction schemes, several of which are in hand, the company has developed special switchgear. Johnson and Phillips, Ltd., constructed a considerable amount of standard switchgear, and substantial orders were received from abroad.

Important contracts were secured by the Metropolitan-Vickers Electrical Company for extra high-tension switchgear, with large rupturing capacities. Some 132,000-volt gear is being supplied for the transmission line between the Witbank and Brakpan generating stations of the Victoria Falls Power Company. Each of the circuit breakers has a rupturing capacity of 1,500,000 kilovolt-ampères, and is fitted with condenser bushing terminals, capable of operating at 154,000 volts. Under the contract, the company is supplying transformers with condenser bushing terminals that are interchangeable with those on the switchgear. Experimental work has been undertaken with a view to developing 222,000-volt condenser bushing terminals, which are now available. Armour-clad compound filled switchgear has been developed for three-phase circuits operating at pressures up to 35,000 volts and with rupturing capacities up to 1,000,000 kilovolt-ampères. Important improvements were made in the design of high-tension outdoor switchgear, which was supplied for use on the overhead 6600-volt distribution lines of the Chester Corporation and on the 33,000-volt lines of the Northwich Electric Supply Company and the Salt Union Company.

Electric Traction.

The chief electric traction work carried out in this country was, of course, on the Southern Railway, which opened electric services on the lines from Victoria and Holborn Viaduct to Orpington, both on the main line and on the Catford loop line, and also on the branch from Nunhead to Crystal Palace. For this scheme the English Electric Company supplied 500 300 horse-power motors and forty additional motors are now under construction, whilst the Metropolitan-Vickers Electrical Company is supplying equipments and accessories for ten three-coach trains, and eight two-coach trailer units are being provided.

The English Electric Company supplied four 100-ton locomotives to the Harbour Commissioners of Montreal, Canada. Each of these engines is fitted with four 430 horse-power motors supplied with current at a pressure of 2400 volts, which is obtained from a sub-station containing two 1000-kilowatt English Electric motor generators. Five additional locomotives are to be delivered by this firm early in the spring of 1926, together with three additional 1000-kilowatt motor generator sets. The first large Indian railway suburban electrification scheme was put into operation in February on the Great Indian Peninsular Railway. The rolling stock consists of thirty-eight motor coaches, twenty-six driving trailer coaches and thirteen ordinary trailer coaches. The electrical equipment for each motor coach, consisting of four 275 horse-power, 1500-volt motors and cam shaft control gear, was supplied by the English Electric Company, whilst Cammell Laird and Co. supplied the mechanical parts. The order for thirty-eight electric locomotives for the Japanese Government Railways was completed by the shipment of three English Electric passenger train locomotives to replace those that were sunk in Yokohama harbour during the earthquake of 1924. Locomotives of 25 tons and 40 tons capacity were also supplied to the Toyokawa and Chichibu railways in Japan. The electrification of inter-urban railways continues to expand, and forty-eight additional equipments of the English Electric Company's manufacture were put into service. A multiple unit cam shaft control gear, suitable for the control of a light coach, with four 72 horse-power, 600-volt motors was developed by this firm, and thirty-three of these equipments were supplied for use on tramways and railways abroad. The company's car body works were actively employed during the year. Orders were secured from the Manchester, Leeds, Rochdale, Bury, Oldham, and other corporations, not to mention those obtained from abroad. Considerable progress was made by the Metropolitan-Vickers Electrical Company in the direction of completing the large contract for equipments for 150 motor coaches and 150 trailer coaches for the Sydney suburban railways. Seventeen additional 1200 horse-power locomotives, similar to the original seventy-eight engines supplied by this company to the South African Railways, were ordered for operating at a pressure of 3000 volts direct-current, with multiple unit control and regenerative electric braking. A 100-ton, 2–6–0, 0–6–2 locomotive is being supplied by the Metropolitan-Vickers Electrical Company for the Panlista Railway. This engine is also designed for a pressure of 3000 volts and for regenerative electric braking. For the Euston to Watford and Liverpool to Southport sections of the London, Midland and Scottish Railway the same company is supplying complete electrical equipments for twenty-two 560 horse-power and 530 horse-power motor coaches and thirty-nine trailer coaches. A repeat order for one hundred 200 horse-power traction motors were received from the Dutch railways and many orders were secured for tramway motors.

Many of the British Thomson-Houston Company's railless trolley omnibus equipments with contactor control were ordered and put into service and many tramway equipments were supplied to various undertakings. Motor-driven air compressors for air brakes on electric trains, as used on the Underground Electric Railways of London, were supplied in considerable numbers, and electric train control equipments were made for the London, Midland and Scottish Railway. An order was received for coach equipments for the suburban electrification of the Bombay, Baroda and Central India Railway. The order covers complete electrical equipments for forty motor coaches and 120 trailer coaches required on the 21 miles' length of line between Churchgate and Borivili, about to be converted from steam to electrical operation at 1500 volts, with overhead trolley line and track return. Each motor coach is to have four 275 horse-power motors. Control is on the automatic electro-pneumatic system, as developed by the British Thomson-Houston Company. For the Canadian National Railways the company is manufacturing eight 85-kilowatt, 600-volt traction generators, specially designed for coupling to Beardmore Diesel engines on oil-electric cars. The generators are provided with one roller bearing and with an overhung exciter. The sets are started up from a battery by means of a starting motor designed for battery voltage.

The General Electric Company also reports that its traction department was active. Thirty traction motors, together with control gear and equipments, were ordered by the London Electric Railway; control equipments by the London, Midland and Scottish Railway; and traction motors for the Birmingham, Bury, Sheffield, Bournemouth, and Leeds Corporations.

Hawthorn, Leslie and Co., Ltd., supplied an electric storage battery locomotive operating on the variable voltage regenerative system—embodying Captain Durtnall's patents—to the War Office, whilst another was built for the Mines Competition, which took place last year. It is shown by Fig. 7. The principle of this type of locomotive was dealt with in our issue of June 13th, 1924. A very interesting locomotive of this type is an alternating-current trolley locomotive now nearing completion, to the order of the Koppers Coke Oven Company, of Sheffield, and to be used at a new coke oven plant in this country. It will also operate on the variable voltage regenerative system, current being taken from a three-phase 50-cycle alternating-current line. Practically infinitely variable speed is obtainable without the use of any main resistances, and consequently the system should prove very efficient. This system has, it is claimed, qualities that make it especially fit for coke oven work, as it is necessary that the locomotive should be capable of crawling at a very slow speed while the coke car is being filled with white hot coke from the ovens.

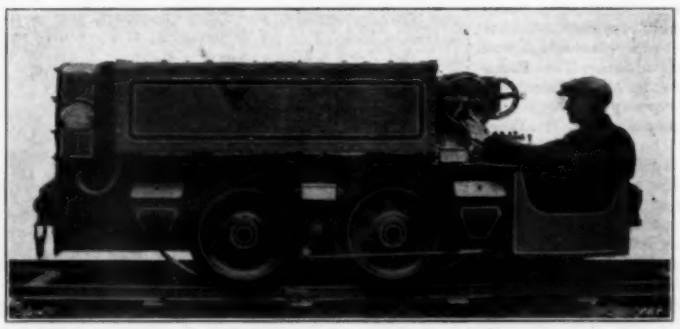


FIG. 7—STORAGE BATTERY MINE LOCOMOTIVE—HAWTHORN, LESLIE

Rolling Mill Plant.

For the new plate mills of the Consett Iron Company the English Electric Company supplied electrical equipment. A 40in. reversing slabbing mill and a large 42in. plate mill are now electrically operated. For both of these equipments duplicate drives have been provided, each consisting of a double armature reversing motor, with a maximum output of 1400 horse-power at 50 revolutions per minute. Each motor is supplied with current from a fly-wheel equaliser set, consisting of a 2500 horse-power driving motor, two variable voltage direct-current generators, and a 48-ton fly-wheel. A light plate mill, driven by a 2500 horse-power induction motor and a chequer plate mill, driven by a 750 horse-power motor, are on the point of being put into operation. There are no fewer than two hundred and twenty-five direct-current motors which are employed for driving live rolls, shears, skids, cranes, &c. At the works of John Summers the same firm aplied the electric drive to a set of sheet mills which were originally driven by steam. A 2000 horse-power induction motor now drives the mills through reduction gearing, and fly-wheels are fitted on each end of the pinion. At the mills of W. Wesson and Co., of Wednesbury, another conversion from steam to the electric drive was made. A rotary transformer converts the incoming two-phase supply to direct current, and feeds the two motors; one of which is rated at 375 horse-power, and the other at 275 horse-power. The final displacement of steam is taking place at the works of Raine and Co., where three additional direct-current motors, made by the English Electric Company, are being erected; one rated at 400 horse-power and the other at 300 horse-power. Electrical equipment built by the same firm for a new tube-making plant, was set to work in Sheffield, and in this case the motor is operated on the Ward-Leonard principle. At the Warrington Works of the British Aluminium Company a reversing mill equipment, consisting of a 28in. plate mill driven through gearing by a 1800 horse-power motor running at a speed of 330 revolutions per minute, was set to work. The motor is supplied by a fly-wheel equaliser set, consisting of a 300 horse-power driving motor and a 10-ton fly-wheel running at a speed of 1000 revolutions per minute. For a new tin-plate works belonging to the Elba Tin-plate Company, the English Electric Company is supplying a 4000 kilowatt turbo-alternator unit, two 1000 horse-power induction motors for driving hot tin-plate mills, and three 200 horse-power asynchronous-synchronous motors for driving the cold mills. Motors of the same type and made by the same firm were supplied to John Summers, and to a metal mill in Birmingham. Other work of this nature was carried out by the English Electric Company in the Sheffield district and abroad.

Rolling mill contracts were also obtained and carried out by the Metropolitan-Vickers Electrical Company. A 1800 horse-power and two 1200 horse-power sheet mill motors are being built for a large Japanese steel works, and a number of smaller installations. Work was completed on the installation of a 1300 direct-current motor, designed for a speed of 32 revolutions per minute, for Smith and McLean, Ltd., of Glasgow, and on a 4500/25,000 horse-power motor and fly-wheel equaliser set, for a 34in. universal plate mill at the Clydesdale works of Stewarts and Lloyds, of Glasgow.

Mining Plant.

There appears to have been a fair demand for electric winders, especially for use abroad. The English Electric Company erected in India a winder designed to deal with 102 tons per hour from a depth of 4000ft., the net weight per lift being 4½ tons. The winder works on the Ward-Leonard principle, and is of the double drum type, with two direct-coupled motors, each rated at 910 horse-power at a speed of 58 revolutions per minute. Another large winder constructed by this firm will shortly be put into operation in Kent. This also works on the Ward-Leonard principle, and is driven by a single direct-coupled motor rated at 2300 brake horse-power at a speed of 61 revolutions per minute. It will deal with 144 tons per hour from a depth of 3100ft. Several smaller winders working on the three-phase system were built by the English Electric Company, two having been supplied to India and two to the Malay States. Repeat orders for two large winders working on the Ward-Leonard system were received from South Wales, and two large three-phase geared winders are being built for Canada. Each of these three-phase winders will deal with 250 tons of coal per hour from a depth of 3200ft., and each motor is designed to develop 2000 horse-power at a speed of 500 revolutions per minute. For South Wales this company is also building a three-phase geared winder designed to deal with 115 tons per hour from a depth of 2500ft., and in this case the motor develops 1200 horse-power at a speed of 375 revolutions per minute. Another winding engine is

being built for India is a double-drum machine working on the Ward-Leonard system, with fly-wheel load equalisation, and is designed to deal with 77 tons per hour from a depth of 4200ft. Orders for many smaller winders for use abroad were secured by the English Electric Company.

The Metropolitan-Vickers Electrical Company reports a good demand for electric winders of the geared alternating-current and Ward-Leonard types, the latter generally being preferred for the larger installations. The largest equipment in this country is being built by the Metropolitan-Vickers Electrical Company for the Carlton Main Colliery Company, Ltd. The equipment has a normal capacity of 3000 horse-power, and a peak load capacity of 7500 horse-power. An interesting pair of 3000 horse-power Ward-Leonard equipments is being supplied to Crown Mines, Ltd., of South Africa. One of these equipments is to be installed on the surface and the other in the shaft at a depth of 3112ft., to draw from a depth of 3625ft., so that the total depth served is no less than 6737ft. For the New Modderfontein Gold Mining Company the company is building a 4820/8200 horse-power Ward-Leonard winder. Among the geared alternating-current winders being supplied by this firm are a 1107/1742 horse-power winder for Crown Mines, Ltd., a 1040/1620 horse-power winder for Newton, Chambers and Co., for the Holyland Silkstone Colliery; four winders for the Seghill Colliery, Northumberland; and a number of other winders for use in Great Britain. Attention was given by the company's engineers to the development of a battery locomotive, a new system of automatic protection for coal cutters, and new mining switchgear. One of the most interesting electric winder orders received by the British Thomson-Houston Company was for a Ward-Leonard machine with a continuous rating of 1200 horse-power for the Champion Reef Gold Mines of India, Ltd. The equipment, which includes a "permanent" slip resistance of the grid type and a liquid starter for the motor generator, is to operate 4000ft. below ground, and the ultimate depth of the wind will be 4400ft. Owing to limitations of space and weight, two 600 horse-power motors are provided, and each machine is flexibly coupled to a pinion shaft meshing with a gear wheel on the drum shaft. Special constructional methods had also to be adopted in the manufacture of the motor generator, base plate, fly-wheel, &c.

Telephone Cables.

Much might be said about telephone cable schemes in the United Kingdom. The new London–Derby cable, made by Standard Telephones and Cables, Ltd., formerly the Western Electric Company, forms an important link in the telephone systems of Great Britain. Its total length is 127 miles, and it is being laid with 452 loading coil cases, containing a large number of coils. It runs from London *vid* the repeater station at Fenny Stratford to the repeater station at Derby, and, on completion, it will form part of the extensive development work being carried out by the British Post Office, and will constitute a unit of the underground telephone line, which will ultimately be established between London and Aberdeen. On this cable there will eventually be some nine repeater stations situated at various places, such as Leeds, Derby, Catterick, Newcastle, Jedburgh, &c., and in these stations there will be thermionic valve amplifying apparatus, which will reinforce the attenuated voice currents. Western Electric repeaters were installed at Aldeburgh for use at the termination of the Dutch submarine trunk telephone cable, which has recently been laid at the bottom of the North Sea. Several repeater stations were put into use on the Paris–Strasbourg trunk cable, and twelve repeater stations are now under construction for use in connection with a cable connecting Rome with Milan. The Paris–Strasbourg cable, and that linking up Milan, Turin, and Genoa with the Swiss system, are typical examples of ambitious telephone cable schemes abroad. When completed the Paris cable will be 494 kiloms. long, and it will be fully equipped with loading coils and repeaters. The character of the cable varies somewhat in different sections, but it may be considered to consist of seven screened quads of 1·3 mm. conductors, 42 quads of 9 mm. conductors, and 22 quads of 1·3 mm. conductors. Standard Telephones and Cables, Ltd., also manufactured and installed a very large number of loading coils for improving the transmission efficiency of new and existing cables throughout Europe.

Miscellaneous.

There is still much that might be added to this review of the activities of the electrical manufacturers during 1925. Much work was done, for instance, in textile mills, notably by the Metropolitan-Vickers Electrical Company. Two contracts alone secured by this firm involve the supply of motors, with an aggregate capacity of 6500 horse-power. Motors with a capacity of over 35,000 horse-power, together with transformers, control gear and other equipment were supplied by the same firm to Brazil. Important work was carried out in connection with the application of electricity to ships, by Laurence, Scott and Co., who, in conjunction with Donkin and Co., Ltd., of Newcastle-on-Tyne, manufactured a considerable number of "all electric" steering gears, more than 50 per cent. of which are for ships being built in foreign countries. Laurence, Scott also supplied electrical gear, as described in our articles on the recent Machinery and Shipping Exhibition, for 58 cranes for the Mersey Docks, and, in conjunction with Stothert and Pitt, the firm designed an "all electric" railway capstan. Unfortunately, we have been unable on this occasion to find space to deal with the activities of the power cable manufacturers, which seem to have had a busy year. The electrification of the Southern Railway alone involved the laying of a considerable amount of cable. No fewer than 130 miles of 11,000-volt three-phase cable were laid by Johnson and Phillips, Ltd., for this undertaking, and some 50 miles of 3300-volt cable. In the past British electrical manufacturers have done little in the way of building frequency changers, and if the Government's proposal to standardise frequency is put into operation, the demand for machines of this kind in this country will not, of course, increase. It is interesting to note, however, that during the period under review Bruce Peebles and Co., Ltd., built two 3000-kilowatt frequency changers for the Glasgow Corporation and two 2000 frequency changers for the South Wales Power Company. This firm also seems to have secured a very fair number of orders for motors, especially for use in textile mills, milling works, &c. Interesting particulars have been supplied to us by Crompton and Co., Ltd., concerning the electrification of factories. A cane sugar mill at Tully Muir, North Queensland, was electrified by this firm. All the machinery, with the exception of the main crushing rolls, which are still worked by steam, is now electrically driven. Medium speed Crompton alternators supply the mills with 50-cycle three-phase current at a pressure of 415 volts, and many of the motors are auto synchronous machines. The complete electrical equipment of six tin dredgers for the Malaya Tin Dredging Company also involved the manufacture of a large number of these motors. Beet sugar factories and cement mills were also electrified by Crompton and Co.

Harbours and Waterways in 1925.

THE year 1925 showed no improvement in the rate of development of dock and harbour undertakings at home ports, although in many overseas ports works of extension and improvement are being carried out on a large scale. This is particularly marked in the United States of America and Canada, where vast sums are being spent on harbour construction and the improvement of inland waterways. The number of Bills having reference to port works dealt with in the Session 1924–5 of the Imperial Parliament shows no advance on the business of the past few years, and in the present Session such Bills are conspicuous by their absence.

The United Kingdom.

Port of London.—In April Lord Devonport, who had been the chairman of the Port of London Authority since its constitution in 1909, retired from that position and was succeeded by Lord Ritchie of Dundee. During the period of Lord Devonport's chairmanship over 12 million pounds were spent by the Authority on improvements in the port. At the beginning of the year Sir Cyril Kirkpatrick, the chief engineer of the Authority, retired from its service. The Authority has recast its scheme for further extensions at the Tilbury and other docks; the Tilbury scheme has been modified, but a new entrance lock of large dimensions, the graving dock and the deep water passenger landing stage in the river are retained in the new proposals, which are estimated to cost about £2,500,000. These works have already been authorised, and financial assistance has been promised by H.M. Government. Other improvements already authorised or in progress include a new entrance at the South-West India Dock, communicating passages between that dock and the India and Millwall Dock systems, as well as the construction of extensions at the Surrey Commercial Dock, 15 acres in extent, which is now nearing completion. The trade of the port in the last financial year exceeded 45 million tons.

The Mersey and Manchester Ship Canal.—The formation and maintenance of a deep water channel through the Mersey Bar and shoals have been for many years problems of difficulty. The quantity of material removed in recent years from the bar channels and the river approaches has averaged about 20 millions of tons annually, and in 1924–5 this figure was slightly exceeded. The revetment of the sides of the Crosby Channel, begun in 1907, was continued, and the training walls or revetments on the east side of the channel, begun in 1907, were extended; but most of the work at present is being done on the opposite or west side. A commission of engineers was recently appointed by the Mersey Docks and Harbour Board to review the progress made with this work and to consider proposals for its further extension. In spite of all the efforts made to improve the main channel by intensive dredging and training, the minimum depth of water in the approach channels has not been increased since 1907, when it was 26ft. or 27ft. at L.W.O.S.T. The Gladstone Dock extensions begun by the Board in 1910 are still in progress, the annual expenditure on these works exceeding one million pounds. The Gladstone Dry Dock, which was closed in 1922 during the construction of the river wall, which will enclose the new dock system, is still out of use. The 80ft. lock entrance at the Alfred Docks, Birkenhead, is also not yet completed.

During the year a good deal of reconstruction work was done in connection with the ferry landing stages on the Cheshire side of the river, and the remodelling of that at Seacombe was completed. Progress was made with the construction of the Bromborough Dock on the Cheshire bank of the river Mersey for Messrs. Lever Bros., work on which was begun early in the year. The Manchester Ship Canal was deepened from 28ft. to 30ft. from the entrance locks at Eastham to Ellesmere Port, a distance of about 4 miles, and further additions were made at Trafford Park to the accommodation provided by storage and transit sheds. Two large transit sheds, constructed of reinforced concrete, are now being erected.

Bristol Channel and South Wales Ports.—At Avonmouth the extension of the Royal Edward Dock by the Bristol Docks Committee is being actively proceeded with. The new arm of the dock will be 1700ft. long and 400ft. wide. At the Great Western Railway Docks at Cardiff, Barry, Newport, Swansea, &c., attention during the year was directed principally to the remodelling and improvement of the mechanical appliances of the docks, the replacement of old and worn out entrance gates and the provision of new and larger coal hoists intended to make the general use of the 20-ton wagon possible. The railway company now has 27 such hoists at work in the South Wales Docks, and 22 are in course of construction or adaptation. The Mountstuart Eastern Dry Dock at Newport was lengthened by 55ft. to 425ft., and can now accommodate vessels having a beam up to 54ft.

North-East Coast and Humber Ports.—The Newcastle City Council decided to carry out a further extension of the Newcastle quay, which will provide four additional berths at a cost of £150,000. The dry dock at Hebburn-on-Tyne belonging to Hawthorn, Leslie and Co., Ltd., which was the scene of a somewhat extraordinary accident in April, when the caisson closing the entrance collapsed, is now being repaired and a new entrance is to be constructed. The new coaling staiths for the use of the trawler fleet and tug boats which were constructed by the Tyne Improvement Commissioners at Whitehill Point, North Shields, were put into service in January. At Blyth the Harbour Commissioners and the London and North-Eastern Railway Company, completed the superstructure of the new coaling staiths, and at Sunderland the new dry dock, constructed for T. W. Greenwell and Co., was opened in July. This dock is 515ft. long internally and 75ft. wide at the entrance, and has a depth of 26ft. over the sill at H.W.O.S.T. It is entered from tidal water. The Scarborough Harbour Commissioners obtained assistance from the Development Commissioners towards the cost of a scheme of improvement at Scarborough Harbour involving an expenditure of £45,000, and a commencement was made with a portion of this work. The London and North-Eastern Railway placed a contract for the reconstruction of the ferry pier at New Holland on the Lincolnshire side of the Humber at a cost of £84,000. The railway company is also engaged on the remodelling of dock machinery and appliances at Tyne Dock, Hull and Immingham. Serious damage was done by sea erosion to the outer piers at Seaham Harbour, and costly remedial and reconstruction works will have to be undertaken.

Southampton.—Work on the great scheme for extensions of the Southampton Dock system at a cost of 13 million pounds, to which reference was made in our review a year ago, was not begun, but a good deal of preliminary work was done. The Southampton Harbour Commissioners are engaged in dredging the channel leading to the port, which now has a minimum depth of 35ft. at low water. The deep-water channel is being widened in places.

Scotland.—The Clyde Trustees are busy with the construction of their new docks at Shieldhall, work on which was begun in the spring of 1924. The cost of the complete scheme will be approximately two million pounds. The enlargement of the Garvel Graving Dock, for which the Greenock Harbour Trustees accepted a tender towards the end of 1924, has now been abandoned, at any rate for the present. Some reconstruction work was carried out at Methil Docks by the London and North-Eastern Railway Company in connection with the dock walls.

Other Ports.—At Holyhead the deepening of the inner harbour was completed during the year, and on March 8th the cross-channel mail service was transferred from the Admiralty Pier to the quays in the inner harbour.

The Isle of Man Harbour Commissioners decided to extend the breakwater at Douglas by the addition of 800ft. at an estimated cost of £750,000.

The Dover Harbour Board, which took over the Naval Harbour from the Admiralty in 1923, decided to apply for parliamentary powers to enable it to close the western entrance to the harbour. The object of this work is to secure more shelter than exists at present during stormy weather for cross-Channel and other vessels lying in the harbour and in the passenger landing berths. The harbour railways will be

extended on to the present island breakwater, thus providing additional berthing accommodation.

The Southern Railway is credited with the intention of taking over and developing the harbour at Newhaven, which for many years has been in its occupation as lessee. The railway company was engaged during the year on the reconstruction of the pierhead and landing stages at the seaward end of the company's pier at Ryde. A large part of this work has been carried out in reinforced concrete.

The Great Western Railway enlarged the small graving dock at Millbay, Plymouth, and carried out other improvements, including dredging and additions to the warehouse accommodation at the docks.

The Harwich-Zeebrugge train ferry service, which was opened in April, 1924, in the first eleven months of working dealt with a traffic of just over 40,000 tons, nearly all of which represented imports. The first eleven months' working showed a loss to the company of over £25,000.

Naval Dockyards.—The most important event in connection with Admiralty Dockyards in the United Kingdom during the year was the decision of H.M. Government to reduce the dockyards at Rosyth and Pembroke to a care and maintenance basis, and to concentrate all Admiralty home dockyard work at the remaining yards at Portsmouth, Devonport, Chatham and Sheerness. The Navy Estimates for 1925–26 show a considerable decrease in the sum to be spent for naval works, docks, &c., the vote, amounting to £2,588,000, being nearly half a million pounds less than that for the preceding year and well below the pre-war figure of about 3½ millions. A large part of the expenditure is to be devoted to provision of new oil storage accommodation both at home and at naval stations overseas. No. 5 basin entrance at Plymouth is to be widened.

British Waterways.—The Corporation of Nottingham completed in October the construction of the lock at Gunthorpe, which forms a portion of the improvement of the Trent Navigation which is now being carried out. Only Hazleford Lock now remains to be completed out of the four locks included in the scheme. When this lock is open to traffic the river Trent up to Nottingham will be navigable by barges of 120 tons capacity at all seasons of the year.

The improvement of the Yorkshire Ouse and the upper reaches of the Humber at the junction of the latter river with the Trent and Ouse at Trent Falls was the subject of a good deal of discussion during the year between the Aire and Calder Navigation Company and the Humber Conservancy. The Navigation Company proposes to seek powers for further works, and a technical commission of engineers was appointed to advise on the best means of effecting the desired improvements.

The Ministry of Agriculture and Fisheries appointed in the spring of the year a Committee to investigate the whole problem of the drainage and navigation of the Great Ouse. This Committee has not yet submitted its report.

European Ports.

France.—The unsatisfactory state of French finances had the effect of restricting public expenditure on port works and inland navigations. Progress was, however, made with the harbour extensions at Marseilles, Havre and Boulogne. The canal between the Rhone at Arles and Marseilles is now nearing completion. The great tunnel of the Rove—which is nearly 4½ miles long, has a width of 72ft. and a height of 47ft. above water level, and is the principal feature of the new canal—has been pierced. The Marseilles Chamber of Commerce embarked upon a further scheme of port development which will take the form of the construction of a new outer port. The large dry dock at Havre was not completed ; it is, however, expected to be ready for service during the present year. The new outer breakwaters and the quay extensions in the outer harbour are also still under construction. The ambitious programme for the creation of a large inland port at Paris made slow progress towards realisation owing to lack of funds.

Italy.—Financial considerations hindered work on several of the large development schemes in Italian harbours, and it was reported early in the year that work had been suspended on the extensions in the port of Naples.

Germany.—The port of Hamburg recovered from the stagnation of the war years and the years immediately following the Armistice. Some extension of quayage accommodation was carried out, but the main expenditure has been during the last two or three years devoted to the modernising of port equipment on the improvement of which large sums are now being expended. A new harbour is in course of construction at Königsberg.

Belgium.—The dock extensions at Antwerp, which constitute the most important harbour work carried out in Belgium since the war, are steadily growing. The lock at Kruisschaus, which is nearing completion, is 886ft. long, 115ft. wide, and has a depth over the sill of 46ft. at high water. A commencement has also been made with the construction of the *bassin canal*, which is, in effect, a series of enclosed docks extending from Kruisschaus on the Scheldt, 7 miles below the city, to the old dock system higher up the river at Antwerp. For the construction of these works caisson and concrete monolith foundations are being extensively employed.

Holland.—In Holland the enlargement of the North Sea–Amsterdam Ship Canal and the construction of the new entrance to it at Ymuiden are the principal works in hand at the present time. The lock will be one of the largest in the world ; work on it was begun in 1922. The development of the port of Rotterdam is still engaging attention. The trade of the port is increasing rapidly, and the intensive dredging in recent years of the artificial channel between Rotterdam and the sea at the Hook of Holland has now resulted in a depth of over 30ft. being available throughout the navigation at low water of spring tides. The first section of the great dam across the Zuider Zee, viz., that part between North Holland and the Island of Wieringen, was completed in 1924. It is expected that it will take another eight years to close the Zuider Zee, after which the reclamation of a portion of the enclosed area will be proceeded with. Work is now proceeding on a portion of the dam between Wieringen and Friesland, and the construction of the first group of locks and sluices near the Island of Wieringen is in hand.

Continental Waterways.—The cessation of dredging at the Soulina mouth of the Danube during the war period resulted in rapid decrease of the navigable depth, which, combined with the continuous growth seaward of the deltaic deposit, so reduced the depth at and near the ends of the training jetties at the mouth of the river as to compel resort in 1924 to a subsidiary channel of limited depth on the north side of the entrance, which is now in use temporarily, while an extension of the jetties 6000ft. seaward and the dredging of the direct channel between them are being effected. Before the war the standard depth in the channel was 24ft.

Some activity is being displayed at Strasburg in developing the Rhine port there in competition with that of Kehl on the opposite side of the river. The completion of the Marseilles–Rhone Canal will greatly increase the importance of Strasburg as an inland port.

North and South America.

United States.—In many ports of the United States, particularly on the Pacific Coast, enormous sums of money are being spent on improvements and extensions. The construction of new ports and the development on a large scale of hitherto insignificant harbours are being proceeded with at several points on the Pacific seaboard. This rapid expansion, the most marked instance of which is to be found in the port of Los Angeles, has been brought about mainly as a result of the opening of the Panama Canal. Port works on a large scale are in progress, not only at Los Angeles, but at San Diego, Oakland, San Francisco, Seattle, Portland, and other harbours on the Pacific. At the Bremerton navy yard on Puget Sound a fitting-out jetty which will carry a 350-ton derrick crane is being constructed.

The deepening of the navigable channel of the East River at New York is being carried out by the U.S.A. Corps of Engineers. This work, which is expected to occupy several years, will, when completed, provide an access to New York by way of Long Island Sound for the largest class of ship. A large part of the deepening is in rock, which is drilled and blasted before dredging.

Canada.—In Canada the most notable feature of port development continues to be the increased provision which is being made for the shipment of grain. The grain export at Vancouver in 1924 approached 56 million bushels, an increase of over 30 million bushels compared with the previous year, and it is anticipated that the figures for 1925 will show a similar advance of trade. The grain storage capacity of the port is now over 6 million bushels. In two years the export of lumber has more than trebled. It is reported that the new Canadian Pacific pier at Vancouver is nearly completed. The storage and export capacity for grain in other Canadian ports, notably Montreal and Port Arthur, is also being extended. At Montreal over 165 million bushels were handled in 1924, and it is still the greatest grain exporting seaport in the world. A recent addition to the grain plant at Montreal is a two million bushels elevator capable of loading five ocean-going vessels simultaneously. Another elevator at the same port has a capacity of 3½ million bushels.

The new dry dock at Esquimalt, which, after those at St. John (New Brunswick) and Boston, will be the largest in the world, was not completed at the end of the year, as had been expected. Little more than the placing in position of the caisson gates remains to be done. It is stated that the total cost of the dock will be upwards of £1,250,000.

Progress continued on the construction of the new Welland Canal, and contracts for further sections of the work were let during the year. The cost of the canal when completed is likely to exceed 20 million pounds.

At St. John, New Brunswick, the Canadian National Railway is constructing wharves which will form the first instalment of the Courtenay Bay harbour scheme, estimated to cost, when completed, upwards of 6 million pounds.

South America.—The extension of the Valparaiso Breakwater was continued. This work, the outer end of which will have its foundation at a depth of 147ft. below mean sea level, is probably the most noteworthy harbour construction now being carried out in South America.

Africa.

The Prince of Wales opened in June the Congella Dry Dock at Durban, which had been in course of construction for over five years. One of the largest dry docks in the world, it is 1150ft. in length, only a few feet less than those at Boston and St. John, New Brunswick, and 110ft. wide at the entrance. The depth over the sill is 35ft. at L.W.O.S.T. The entrance is closed by a sliding caisson. The improvement of the approaches to the harbour at Durban, which has been so marked since intensive dredging of the channels has been carried out, resulted in a minimum depth of 31ft. at low water being available at the bar and in the entrance channel. The reconstruction and realignment of portions of the entrance jetties was proposed by the engineers advising the South African Government with the object of improving the scour in the entrance channel and the reduction of shoaling by littoral drift. Some part of these improvements was begun. It is hoped that a minimum depth of 36ft. at low water will be available in the entrance channel when the improvements have been completed. Already the berths alongside the principal open tidal wharves in the inner harbour have depths up to 38ft. 6in. at low water.

At Cape Town extensions of the Table Bay breakwater are in progress, and at Port Elizabeth breakwaters are being built which, when completed, will enclose a harbour of 87 acres, a large part of which will have a depth of 36ft. at low water. Both at Cape Town and Durban facilities for the shipment of grain are being extended, and at Durban the equipment for the storage and shipment of coal is being improved. At East London the construction of a new east pier is in hand, and a wharf for ocean-going vessels is being built at Walvis Bay.

In West Africa the steel pier constructed at Port Harcourt a few years ago is being extended. The harbour works at Takoradi are now making good progress, and those at Lagos, which have been in hand since the war, are nearing completion. The intended improvement works at Beira in East Africa have not yet materialised ; it had been anticipated that a commencement would be made during the early part of the year with the construction of the new wharves there. The deep water wharves at Killindini are nearly finished, and the construction of additional wharfage at Dar-es-Salaam has been sanctioned. A reinforced concrete deep water wharf at Zanzibar was completed during the year.

The work of widening and deepening the Suez Canal, which has been in progress almost continuously since 1898, reached the stage when ships drawing up to 33ft. are permitted to traverse it. The 1912 programme, which provided for a minimum bottom width of 45 m. at a depth of 10 m., and a channel dredged throughout to a minimum depth of 12 m., has now been realised, and work is in progress on the programme of 1921, which increases the minima to 60 m. and 13 m. respectively. Many of the bends have been straightened, and a large part of the canal waterway, including all bends, has been widened much beyond the minimum standard.

An international commission of engineers assembled at Alexandria in December for the purpose of reporting to the Egyptian Government on the future development of that port. Coal handling appliances and storage facilities are being provided at Port Sudan, and extension works are in hand at the harbours of Port Said and Suez.

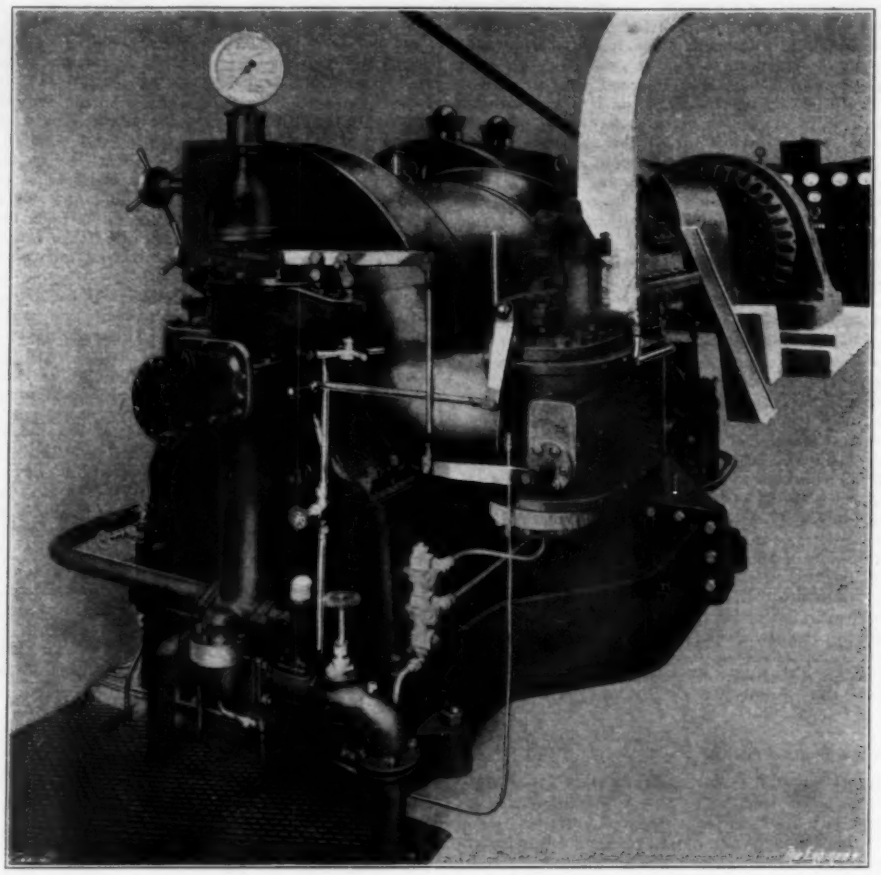
A contract was signed during the year for the construction of harbour works at Funchal, Madeira, by a British firm of contractors. These works, which are estimated to cost between £1,500,000 and £2,000,000, include the construction of a breakwater about 3200ft. long and a large amount of dredging.

The East.

It is expected that the King George Docks at Calcutta, work on which was started in 1920, will be ready for opening in 1927. At Bombay the Back Bay reclamation made steady progress, but the wharf extensions at Karachi are still far from being completed. The harbour projects at Vizagapatam and Cochin are well under way, and it is understood that the improvement of Chittagong Harbour will be proceeded with energetically in the near future. At Vizagapatam three berths with 30ft. at low water alongside are being constructed. A deep water harbour is also being built at another port in Southern India, Tuticorin. At Madras Harbour further extensions of the deep-water quays are being made. Important extensions are being carried out at Hong-Kong Harbour, where it is reported a deep water quay wall, nearly one-third of a mile long, is being constructed for Chinese owners. Projects for the extension of the port on a large scale are now being considered by the Hong-Kong Government and the Port Trust. Preliminary work in connection with the naval base and Admiralty Dockyard at Singapore is still in hand. It is probable that a beginning will be made during the year 1926 upon the construction of some part of the permanent works.

STEAM TURBINE FOR DRIVING A COTTON MILL

W. H. ALLEN, SONS AND CO., LTD., BEDFORD, ENGINEERS

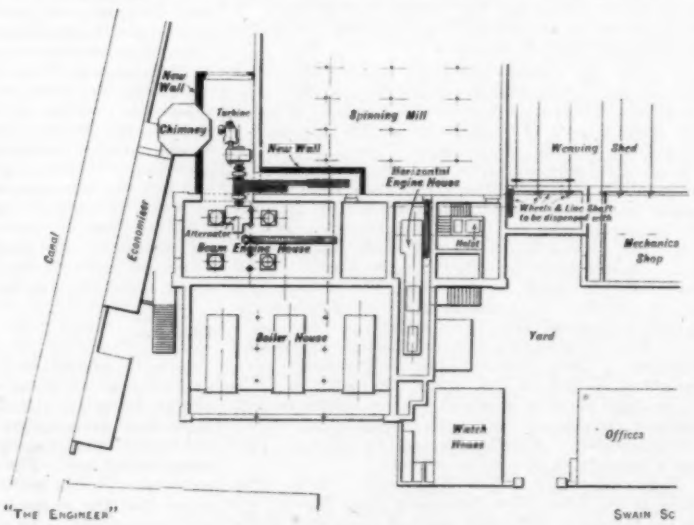


Steam Turbine Plant for an Old Cotton Mill.

AN interesting example of the replacement of an antiquated steam power plant by a modern steam turbine for cotton mill driving was brought to our notice recently. The plant to which we refer is at the Victoria Mill, Rishton, near Blackburn. This is an old mill, built in 1860, and is devoted to both spinning and weaving, the textile machinery embracing 40,000 spindles and 1120 looms. The original power plant consisted of a double beam engine of 900 indicated horse-power, as old as the mill building, and a horizontal engine, the former driving the spinning mill by means of a spur gearing and an upright shaft, while the horizontal engine drove the weaving shed by means of bevel gearing. When it was decided to modernise the motive mechanism the owners of the mill had various schemes to consider, including new reciprocating engines, and electric driving, but it was eventually decided to adopt a geared steam turbine with combined rope and electric drives, the rope drive being adopted for the spinning section and electric motors for weaving. The old and new arrangements are shown in the plan while the half-tone engraving represents a view of the turbo-alternator.

The work of the replacement was rendered all the more complicated by the necessity to maintain all the machinery in operation while the change over was being carried out. This was effected by first installing the turbine and rope pulley in a restricted space between the mill chimney and the mill building and alongside the existing beam engine-house, thus enabling the spinning portion of the mill to be driven by ropes from the turbine. The beam engine and upright driving shaft were then dismantled, and the alternator for supplying the current to drive the weaving shed was erected and coupled to the slow speed shaft of the turbine. This shaft runs at 500 revolutions per minute, and is driven by double helical enclosed lubricated gearing from the main shaft of the turbine, the normal speed of which is 4800 revs. per minute, at which speed the turbine generates 1750 brake horse-power, with steam at 160 lb. pressure per square inch and 650 deg. Fah. total heat. Electric motors were then installed in the weaving shed, commencing at the far end, one motor driving three cross shafts and the necessary speed reduction being effected by double helical gear wheels. When the last cross shaft was coupled up the old weaving shed engine was dismantled. An unusual feature of the electric driving system is that all the motors start up with the generator, thus saving individual starting and loss of time. This is effected by automatically cutting out the overload fuses for each of these motors until the machinery is in full motion, when the fuse mechanism is replaced in its normal position by hand.

The turbine, together with the condensing plant and gearing, was supplied by W. H. Allen, Sons and Co., Ltd., Bedford. It is of their standard type, and is arranged so that a portion of the exhaust steam can be utilised for heating purposes, while the waste steam from the air pump is utilised for heating the feed water before it enters the economisers. The turbine is specially designed so that it can be started up quickly under vacuum, a period of only two minutes being required to attain full speed. Flexible couplings are introduced between the turbine gears and the main rope drum shaft and also between the latter and the alternator.



PLAN OF VICTORIA COTTON MILL

The turbine has seven stages, made up of one compound velocity and six Rateau stages, and the blade speed is approximately 585ft. per second. The blades are inserted in a groove in the forged steel discs, and are held in position by a method of serrations which Messrs. Allen have standardised. The serrations on the blade root and those in the rim of the disc are cut to gauge. The packer or distance piece between the blades is integral with the blade which insures great strength at that point of the blade immediately above the rim of the disc, which would otherwise be the weakest section. The blades themselves pass through a series of machining operations, being milled from drawn bars. The outer end or periphery of the blade is turned to form a pip, and the shrouding is riveted thereon after the assembly of the blades in the disc. The rotational clearances are large, those in the axial direction being not less than $^1/_{16}$in., and those radially in no case being less than $\frac{1}{8}$in. The discs, which are of forged steel, are each assembled separately on the rotor shaft, and supported thereon by two rings, one at each end of the hub. The diaphragms or intermediate stage nozzles are constructed of cast iron, the vanes being of mild steel cast in.

Steam for heating is passed out at a pressure of 5 lb. per square inch, the quantity being 7500 lb. per hour. The pass-out governor gear is of the oil operated relay type. The oil pressure is obtained from the main oil pump of the turbine, and the pressure is utilised by means of a pass-out governor to operate the "pass through" valve on the turbine, so that all the steam not required for heating is exhausted through the latter stages of the turbine and on to the condenser.

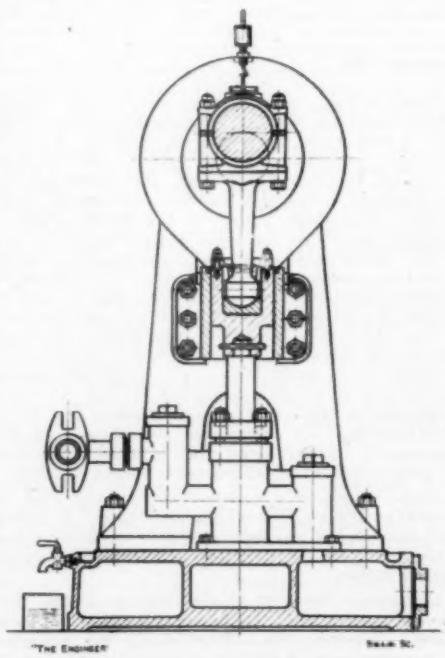
The reduction gearing is lubricated under pressure from the main pressure oil system, the lubricant being directed through nozzles close to the point of contact of the teeth. Any failure in the oil supply causes a powerful spring in the governor gear to close the main control valve, and thereby bring the set to rest, making the arrangement as nearly fool proof as possible. The rope pulley has a mean diameter of 38in., and is provided with grooves for 30 $1\frac{1}{4}$in. ropes, with four additional 1in. ropes to drive the extraction pump of the condenser. The condenser maintains a vacuum of 28in. at the turbine exhaust branch when supplied with 1420 gallons of water per minute at a temperature of 75 deg. Fah. The air and gases are extracted from the condenser by means of a two-stage steam ejector. The primary jet exhausts into a small jet condenser from which the condensate and cooling water are returned through a barometric leg into the condenser, while a secondary jet discharges into a further heater from which the air escapes. All the heat is thus retained. The extraction pump is of the single stage volute type running at 720 revolutions per minute, and absorbing about 43.5 horse-power. As previously mentioned it is driven by ropes from the main pulley.

The electrical portion of the work was supplied by the Electric Construction Company, Wolverhampton. The alternator generates 400 volt, 50-cycle, three-phase current with a normal full load output of 750 kilowatts, and is a twelve-pole open-type machine. The superheaters were supplied by Superheater Units, Limited, Swansea, and the cotton driving ropes by Samuel Pollitt, Limited, Pendlebury, near Manchester.

A New Hydraulic Pump.

A NEW design of hydraulic pump which has been brought out by the West Hydraulic Engineering Company, of Luton, is illustrated by the line drawing below.

The machine, it will be seen, is of the vertical type, and one of its outstanding features is the provision made for lubricating the running parts. A set of sight-feed drip lubricators is fixed in the guard over the crank shaft, so that there is one for each crank. On the top end of the connecting-rod there is a projecting wiper, which, at every revolution, picks up a little oil from the wick of the lubricator. This oil serves to lubricate the crank pin bearing, and then gravitates down the connecting-rod to the small end, which, it will be seen, is of the spherical type. The seating for the ball is arranged in a pocket in the crosshead, and the oil consequently forms a complete bath round the ball. Finally the oil overflows and thus lubricates the bored crosshead guide. A channel is provided round the base of the pump to collect the used oil, which can be drained off, filtered and used again. The main bearings of the crank shaft are of the ring-oiling type.

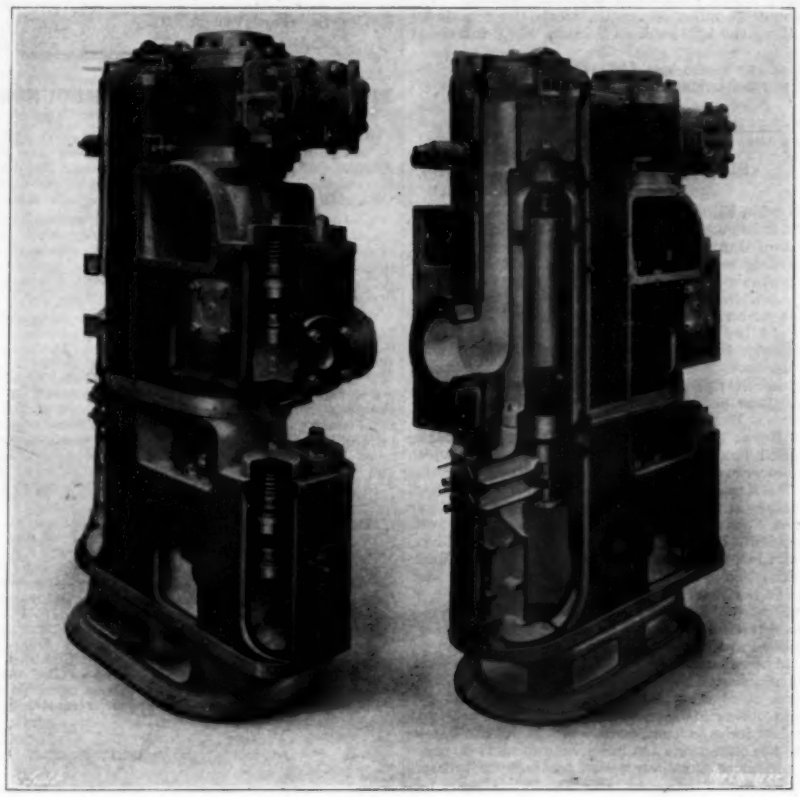


HYDRAULIC PUMP

The barrels of these pumps are of cast steel and are bushed with gun-metal, while the rams are of solid gun-metal. The stuffing-boxes are arranged for hemp packing,

COMBINED FEED-WATER HEATER AND PUMP FOR LOCOMOTIVES

WORTHINGTON-SIMPSON, LTD., NEWARK-ON-TRENT, ENGINEERS



and the glands are lined with gun-metal. The standards carrying the main bearings are of cast iron, and are cored out to accommodate long bolts which reach from the bed-plate right up through the bearing keeps and consequently relieve the standards from all tension.

These pumps are intended to run at fairly high speeds, and in the smaller sizes a speed of 200 revolutions per minute is adopted. They are also, we believe, noteworthy on account of their silent running.

A somewhat similar pump, by the same firm, is of the horizontal type; but in that case it is, of course, necessary to employ a separate lubricator for the small ends, while flat slipper guides are adopted for the crosshead. Some three-throw sets of this type, recently supplied for service abroad, are capable of delivering 35 gallons of water a minute against a pressure of 1500 lb. per square inch and are each driven through machine cut, double-helical gearing by a 50 horse-power electric motor, running at 700 revolutions per minute.

A Locomotive Feed-water Heater.

A COMBINED feed-water heater and pump specially suitable for service on locomotives, which is being manufactured by Worthington-Simpson, Ltd., of Newark-on-Trent, is illustrated on this page.

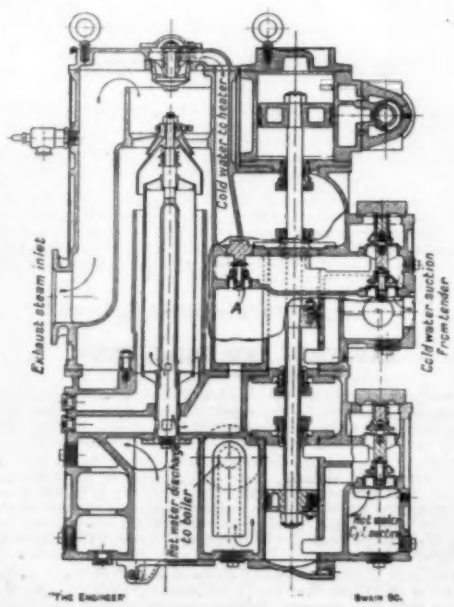
It is unnecessary here to enlarge upon the merits of feed heating by exhaust steam as a means of improving the economy of locomotives and increasing their capacity, but it is noteworthy that the makers are supplying large numbers of these machines to continental railways, while the principal British railways are testing the apparatus in normal working conditions.

In this class of heater the pump must, of course, be supplied with steam, but this call on the boiler only amounts, we are informed, to 2 per cent. of the total steam raised, and its latent heat is returned to the boiler by using the exhaust from the pump to assist in heating the feed. The principal source of heat is, however, the main exhaust, which is tapped to the extent of about 15 per cent. of the total steam used by the engine. The consequent net saving is, according to the makers, from 10 to 12.2 per cent. of the heat required to evaporate the water if cold feed were employed. But, apart from the actual saving in fuel thus effected, the arrangement has the advantages that the length of journey which can be made with the supplies of coal and water on board the tender is extended, and there is a reduction in the amount of scale-forming material passed into the boiler, with the feed water, to the extent of the exhaust steam condensed and returned with the feed.

The apparatus itself is comparatively simple and comprises a direct-acting pump with two water barrels and a direct-contact heating chamber. These two essential parts are arranged in one casing and the whole is fixed on the running plate alongside and against the boiler. The result is that the heater is kept warm by the heat radiated from the boiler, and when, it is not in use in cold weather, it is saved from being frozen up so long as the boiler keeps its heat.

The reason for having two barrels to the pump is the fact that the cold water coming from the tender must first be got into the heating chamber, which is at approximately atmospheric pressure, and, after being heated, must be forced into the boiler. The pump is of the normal direct-acting type and, as will be seen from the sectional drawing, it is the upper barrel which is used for handling the cold water. The water from this pump is delivered up a passage-way cored out of the heater casing to a mushroom valve at the top. This valve is lightly loaded with a spring and consequently distributes the water as a fine spray in the steam space.

The heating steam is supplied by a large pipe which is connected with the cylinder exhaust ports by means of holes cut in the back of the exhaust chest, so that the heating chamber is supplied with steam at practically exhaust port pressure. The exhaust from the working cylinder of the pump is also led into the supply of heating steam. The steam is passed through a separator on its way to the heater in order to extract any oil it may contain, and we are informed that the separation is really effective.



SECTION OF FEED-WATER HEATER AND PUMP

As the cold water falls through the heating chamber it condenses the steam and, in warming up, deposits a large proportion of its scale-forming material. This material, however, does not adhere to the metal surfaces as hard scale, but forms a muddy deposit, which can be easily cleaned out through several plug holes. In any case the effectiveness of the heater is independent of scale, as the water is heated by direct contact with the steam. The mud blown out of the heater obviously represents so much scale-forming material saved from going into the boiler. The hot water is drawn from the bottom of the heater by the lower pump and is forced into the boiler through the usual check valve.

It will be understood that there is a free supply of exhaust steam to the heater and provision must consequently be made to prevent an accumulation of water in the heater which would choke it up. For this reason the cold water pump is made to deliver slightly more than the hot pump, and the surplus water not required for feeding the boiler is circulated round a by-pass. This by-pass can be seen in the sectional drawing and is controlled by a bucket float in the heating chamber. This float is open at the top and slides up and down on a hollow central stem. It will be noticed that the float is protected by an umbrella-like cover, which prevents water from dropping into it directly from above. On account of the excess delivery of the cold water pump there is a tendency for the water level to rise in the heating chamber and ultimately it flows over the top edge of the bucket float, as the float is prevented from rising any further by a spring stop. As the bucket fills it sinks, and in doing so uncovers ports cut in the hollow central stem. The water in the bucket can then escape through the stem into the by-pass passage and the float rises again. The by-pass leads to a valve, marked A in the drawing, which is on the suction side of the cold water pump valve chest. The consequence is that all the water coming by way of the by-pass is sucked up by the pump and is re-circulated round the system, while a correspondingly lesser amount of cold water is drawn from the tender. In this way, it will be seen, a constant level is maintained in the heating chamber regardless of the relative conditions of the steam and water supplies. The apparatus is, of course, provided with all the necessary fittings in the way of lubricators, a safety valve on the heating chamber, and means for draining off the water as a precaution against freezing up.

An objection which is sometimes raised against the use of exhaust steam on a locomotive for feed heating is that the steam going up the blast-pipe is depleted and consequently the draught through the fire is reduced. It should be borne in mind, however, that the use of the feed heater reduces the amount of coal which need be burned to raise a given amount of steam. In a concrete example, for instance, it was found that on a locomotive developing 2000 indicated horse-power the Worthington heater reduced the amount of steam available for producing the draught by 12½ per cent., as compared with injector feeding, when the whole of the exhaust would go up the chimney. On the other hand, the amount of coal burned went down by 18¾ per cent. In other words, there were 87½ parts of exhaust steam left to help in burning 81½ parts of coal, and there was an actual excess of draught as compared with injector feeding.

CALENDARS, DIARIES, &c.

INTERNATIONAL COMBUSTION, Ltd., Africa House, Kingsway, W.C. 2.—Pocket diary for 1926.

ASHWELL AND NESBIT, Ltd., Barkby-lane, Leicester.—Wall calendar with daily tear-off sheets.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 2, Norfolk-street, Strand, W.C. 2.—Pocket diary for 1926.

EVERSHED AND VIGNOLES, Ltd., Acton-lane Works, Chiswick, W. 4.—Wall calendar with monthly tear-off sheets.

THE STAVELEY COAL AND IRON COMPANY, Ltd., near Chesterfield.—Leather pocket diary with note-book included.

THE IRONITE COMPANY, Ltd., 11, Old Queen-street, Westminster, S.W. 1.—Wall calendar with monthly tear-off sheets.

BRITISH INSULATED AND HELSBY CABLES, Ltd., Prescot, Lancs.—A set of date blocks for 1926 to fit into calendar frame.

W. RICHARDS AND SONS, Ltd., Britannia Foundry, Middlesbrough.—A copy of the sixth annual chart of iron and steel prices, 1914–26.

THE ASSOCIATED BRITISH MACHINE TOOL MAKERS, Ltd., 17, Grosvenor-gardens, S.W. 1.—Wall calendar with monthly tear-off cards.

WEBSTER AND SON, Ltd., 104, Baker-street, W. 1.—Calendar with monthly tear-off slips. A picture in colours entitled "A Hazy Morning."

S. HILDESHEIMER AND CO., Ltd., 96, Clerkenwell-road, E.C. 1.—A coloured picture, "The Lighted Gateway" (Westminster School), by Fred Roe.

AITON AND CO., Ltd., Derby.—Fine art wall calendar. A Collotype reproduction of a pastel "Marigold," by L. M. Cohen. Monthly tear-off sheets.

ANDREW BARCLAY, SONS AND CO., Ltd., Caledonia Works, Kilmarnock.—Wall calendar with pictures of the firm's products printed on the calendar.

HART ACCUMULATOR COMPANY, Ltd., Marshgate-lane, Stratford, E. 14.—One desk blotter. A large wall calendar with monthly tear-off sheets.

SIMPLEX CONDUITS, Ltd., Garrison-lane, Birmingham.—Pocket diary, 1926. The diary is printed on squared paper. Useful information is included.

MARSHALL, SONS AND CO., Ltd., Gainsborough.—Wall calendar two months to a page. A picture applicable to "Marshall's Products" appears on each sheet.

J. I. THORNYCROFT AND CO., Ltd., Thornycroft House, S.W. 1.—Calendar with monthly tear-off sheets. Pocket wallet for Treasury notes, stamps and cards.

BRAITHWAITE AND CO. (ENGINEERS), Ltd., Broadway Buildings, Broadway, S.W. 1.—Diary for 1926. Many useful particulars for structural engineers are included.

"UNDERGROUND," Electric Railway House, Broadway, Westminster, S.W. 1.—Wall calendar with monthly tear-off sheets. A coloured picture appears each month.

NEGRETTI AND ZAMBRA, London.—A clinical thermometer in an Easy-setter case, thus avoiding hand shaking when the instrument requires to be reset before taking a reading.

C. A. PARSONS AND CO., Ltd., Heaton Works, Newcastle-on-Tyne.—Wall calendar with monthly cards. A different picture appears on each card dealing with products of the firm.

THE DE HAVILLAND AIRCRAFT COMPANY, Ltd., Stag-lane Aerodrome, Edgware, Middlesex.—Calendar with monthly tear-off slips. A picture of the De Havilland "Moth" is attached.

JOHN ROGERSON AND CO., Ltd., Wolsingham S.O., Co. Durham.—Wall calendar with monthly tear-off sheets, each of which bears a picture dealing with one of the firm's manufactures.

LANCASHIRE UNITED TRAMWAYS, Ltd., Atherton.—Wall calendar with monthly tear-off sheets. "The Goose Girl," a watercolour by Walter Royle, is reproduced in a colour gravure print.

Van Ryneveld's Pass Irrigation Works.

THERE is always interesting matter in the unofficial but authoritative reports which follow the completion of irrigation works in South Africa, and an article on the Van Ryneveld's Pass irrigation works, published in the October issue of *South African Engineering*, is no exception. In this case the chief feature of the account is the description of the methods followed and the plant used in excavating for the foundations and the building of the dam.

A preliminary survey for the project was made by C. H. Warren in 1918, and in the following year a detailed survey was carried out by the irrigation department. The site of the dam is one mile north-west of Graaff Reinet, on Sundays River. The catchment has an area of 1477 square miles, with an average rainfall of about 14½in. The river has not been gauged, and the estimate of the quantities of water available is based on the probable ratios of run-off. The water is supplied to the Kendrum Settlement, some 20 miles away, the irrigable area being 10,543 morgen, or 22,314 acres, a little less than 35 square miles. It is expected that it will be possible to irrigate the whole of this area in years of unusually good rainfall, and about 8000 morgen, nearly 17,000 acres, in normal years, by means of a system of canals, totalling 60 miles in length.

The dam is of the gravity class, without curvature, and is built of concrete throughout. For most of its length it is an overflow weir, but since the materials of which the left bank is composed are not resistant enough to withstand the action of pouring or swirling water, the portion of the crest near that bank is not submerged. A separate weir is provided on that bank, a sound feature, for such a weir allows of the depth of water passing over the crest of the dam being less than it would otherwise be, thus reducing the probability of scour, or lessening the cost of the protective works. At intervals downstream there are three diversion weirs, providing canal intakes, only a small local supply being taken from the reservoir itself. The upstream face of the dam is vertical and the downstream face stepped. In order to reduce the pounding action of the water at the toe the flights of steps are staggered.

The dimensions of the dam are:—Length, 1170ft.; crest width, 10ft.; height above river bed, 109ft.; height above lowest part of foundation, 152ft. The levels are:—River bed, R.L. 2484; outlet, 2510; full supply level, 2584; highest flood level, 2590; crest, 2593. The capacity of the reservoir is 64,000 acre-feet, which is 2788 million cubic feet, or 79 million cubic metres. The water spread at F.S.L. is 2800 acres, and at H.F.L. 3408 acres. The provision of movable shutters, to raise the water level 6ft., is contemplated, in case the capacity of the reservoir should become much reduced by silting. The increase to the then capacity of the reservoir would be 19,400 acre-feet—say, 845 million cubic feet, or nearly 24 million cubic metres.

EXCAVATION AND BUILDING.

In excavating for the foundations of the dam, where not in the river bed, the following means were employed. About 30,000 cubic yards were excavated by donkeys pulling "Fresno" scrapers, this method proving economical as long as dumping could take place both upstream and downstream, so that the teams could drag spoil at each time of crossing the excavation in a to-and-fro trip. By the time that a depth of 10ft. had been reached it was no longer possible to allow dumping to take place upstream, while, besides that drawback, the working haul was up a ramp of 1 in 10. Work with these scrapers was therefore confined to a small part of the excavation, most of the work being now done with "Koko-pans" drawn by teams of donkeys on light rail tracks. In July, 1922, endless rope haulage was installed, worked by a 12 horse-power engine, and did good work. It was used later on for supplying sand. Towards the end of 1922 a 5-ton electric crane was put into use and it considerably speeded up the work. Most of this bank excavation was in "soil" to a depth of 20ft., below which depth it was in clay gravel, with boulders mostly ranging from 1 cubic foot to 1½ cubic yard in size. These could conveniently have been dealt with by means of a power shovel, but it was decided that the gain would be more than offset by the cost of installing it.

The excavation in the river bed was done in the dry season of 1923, the plant used including an electric winch, a cableway and skips, and two 5-ton electric cranes. The work was carried on day and night and finished in the September. Most of the rock was sound, and it was not necessary to remove it to a depth of 4ft. throughout, as provided for in the estimates. The rock in the foundation is a dolerite, and most of it dips slightly upstream. In the left flank seamy and decomposed rock was encountered, and in preference to excavating for the whole depth, as intended, a narrow cut-off trench was provided.

In building the dam most of the concrete, in which "plums" are incorporated, was placed from tip trucks, and while the concrete was below ground level one set of trucks ran from side to side of the excavation and another set was used inside it, the concrete being fed from the upper to the lower trucks by means of shoots. Steel sheeting was used for the faces, the sheets for the upstream face being 20ft. by 10ft., and those for the downstream face 15ft. by 10ft. The quarry, situated 400 yards downstream, was worked at an elevation which allowed of a gradient of 1 in 100 down to the dam. The rock used is very heavy, the specific gravity being 3.07, and it is very hard. A cube which was tested broke under a stress of 23,000 lb. per square inch, nearly 1500 tons per square foot. The plant included a 6-ton electrically operated cableway of 1200ft. span; a concrete shuting plant, with towers 240ft. high; three 5-ton derricks, three steam cranes, and two light locomotives. The electrically operated plant was supplied from a principal and an auxiliary generating station, the former supplying direct current at 500 volts and having an output of 300 kilowatts. Anthracite was the primary fuel for two suction gas engines of 230 horse-power and 90 horse-power. The whole scheme of concreting was based on gravity supply of materials, the trucks running on gentle gradients from quarry to crushers, crushers to mixers, and cement shed to mixers. In the last-mentioned case the slope was 1 in 40, and the trucks were equipped with brakes.

The canals are in five "sections." Section "A" draws from weir No. 1 and extends for about 8 miles along the left bank. Section "B" draws from weir No. 2 and extends along the right bank for about 8 miles Section "C" draws from weir No. 3 and extends along the left bank. The water is divided at a parting chamber, one portion being taken across the river to Section "E," which is about 22 miles in length, while the remainder continues along the left bank as Section "D" for about 13 miles.

The cost of the works was £400,000, or about £23 10s per acre of normal irrigation, as estimated.

SIXTY YEARS AGO.

As the London Fire Brigade is celebrating the diamond jubilee of its existence, it may be interesting to record that in our issue of January 5th, 1866, we gave some brief details regarding a very destructive fire that broke out at St. Katharine's Docks on January 1st that year and raged for more than twenty-four hours. The engines brought to bear on the conflagration consisted of one fire float and eight land engines, all belonging to the Metropolitan Fire Brigade, and constructed, with one exception, by Shand, Mason. In addition, at Captain Shaw's request—Captain, later Sir Eyre, Shaw of tuneful memory—Shand, Mason lent three engines from their works and Merryweather's two. It was added by way of contrast, that at the great fire in Tooley-street in 1861, only two floating and two small land steam engines were in attendance, and that there were no others in existence in London at the time. . . . The days of the China "clippers" are recalled by a paragraph in the same issue in which some details were given of "the great ocean race" between the Serica, of 707 tons, built by Steele, of Greenock, and the Fiery Cross, of 689 tons, built by Challoner, of Liverpool. Both ships left Foo-choo-foo for London on the same day and were towed to sea together. They arrived off the Isle of Wight at the same time after a remarkable race. By a stroke of good fortiune a tug ran alongside the Fiery Cross, and taking her in tow, enabled her to reach Gravesend on the same tide. The vessel thus secured the premium for having arrived with the first of the season's teas. Both ships having discharged and loaded again cleared for Shanghai on October 11th, 1865, and began a race outward which promised to be as keenly contested as the run home. A picture of the conditions attending communication with ships at sea in those days is revealed by the fact that the last news of the vessel that could be given at the beginning of January, 1866, was that on November 8th they were both "spoken" somewhere off the Guinea coast. . . . In a paragraph in the same issue we recorded an extraordinary incident on the North-Eastern Railway. At Leamside an engine was standing on the main line with no one on the footplate when a goods train was seen to be approaching on the same rails. The fireman, seeing the danger, jumped up with the object of setting his engine in motion, but scarcely had he got it started when the goods train collided with it and knocked the fireman off. The unattended engine quickly gathered speed and at sixty miles an hour tore along towards Newcastle, narrowly missing a passenger train at Pelaw. In response to telegraphic messages dispatched down the line an engine was prepared to chase the runaway. After an exciting run of sixteen miles the pursuer overtook the quarry, and one of the men—his name should, we feel, at least have been recorded—jumped on to the fugitive and shut off the steam.

EDUCATIONAL INTELLIGENCE.

THE Council of the Institution of Structural Engineers, Abbey House, Westminster, announces that, through the generosity of the British Portland Cement Association, it will be able to award this year a travelling scholarship of the value of £300 for the purpose of studying reinforced concrete construction. The competition will be open to all associate members under the age of thirty-five years. The winner, who will also receive the Gold Medal of the Institution, will be required to travel in America for two months, and on his return to write a thesis on the lessons he has learnt from his tour. Full particulars of the scholarship, together with the conditions of the competition, will be published in due course.

LAUNCHES AND TRIAL TRIPS.

SOUTHGATE, motor vessel; built by Palmer's Shipbuilding and Iron Co., Limited; to the order of the Anglo-American Oil Company; to carry petroleum spirit in bulk; engines, hot bulb; constructed by the builders; launch, November 30th.

CITY OF LYONS, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of the Ellerman Lines, Ltd.; dimensions, 455ft. long; to carry 11,420 tons. Engines, one set of Parson's reaction type turbines and single reduction mechanical gearing, pressure 240 lb.; constructed by the Wallsend Slipway and Engineering Company, Ltd.; launch, December 1st.

DELPHIC, liner; repaired by Harland and Wolff, Ltd., to the order of the White Star Line; dimensions, 450ft. by 58ft. by 40ft.; 8000 gross tonnage. Engines, two sets of triple-expansion, pressure 200 lb.; trial trip, December 2nd.

SIRDHANA, steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the British India Steam Navigation Company, Ltd.; dimensions, 450ft. by 57ft. 9in. by 36ft. 6in.; 9500 tons deadweight. Engines, two sets of triple-expansion steam; constructed by the builders; trial trip, December 12th.

MYRTLEBANK, motor vessel; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co. (Bank Line), Ltd.; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of six-cylinder four-cycle motors; constructed by the builders; delivered to owners, December 29th.

ATHELKING, twin-screw motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the British Molasses Company, Ltd.; dimensions, 475ft. long; to carry molasses, oil or spirit in bulk. Engines, twin-screw, reversible single-acting, marine type; constructed by the builders; launch, December 30th.

MAIMUNA, motor yacht; built by James Pollock, Sons and Co., Ltd., to the order of the Rajah of Sarawak; dimensions, 140ft. by 25ft. Engines, 350 brake horse-power, four-cylinder Bolinder direct reversible, heavy oil marine; constructed by the builders; trial trip, December 30th.

GRANADA, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Standard Fruit and Steamship Company, of New Orleans; dimensions, 326ft. by 45ft. beam. Engines, triple-expansion; constructed by the builders; trial trip, January 4th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. A. G. CLAUSEN, who was for many years associated with J. and E. Hall, Ltd., Dartford, and latterly with Heenan and Froude, Ltd., Worcester, has joined Messrs. Hal Williams and Co., consulting engineers and factory architects, and will assist them more particularly in the refrigerating side of their business.

F. GILMAN (B.S.T.), Ltd., Grange Works, Grange-road, Smethwick, informs us that it has just completed the purchase of the business known hitherto as G. F. Clements and Co., of Regent-street, Smethwick, manufacturers of boiler scaling tools. All business previously carried out by that firm will now be dealt with from the main offices of F. Gilman (B.S.T.), Ltd.

IT is officially announced that the Birmingham Small Arms Company, Ltd., of Birmingham, has entered into an agreement with Standard Telephones and Cables, Ltd.—formerly the Western Electric Company, Ltd.—whereby the developments of the latter company in connection with radio broadcast receiving apparatus will operate for both companies. A new B.S.A. company has been formed under the name of B.S.A. Radio, Ltd., which company will market the new B.S.A. products. The head offices of B.S.A. Radio, Ltd., is at Small Heath, Birmingham. Mr. J. W. Bryan, who is the firm's publicity manager, and who has been closely connected with the company's sales departments, will be in charge of all matters relating to sales of B.S.A. Radio, Ltd.

WE have been informed by Mr. R. P. Sloan, the chairman and managing director of the Newcastle-upon-Tyne Electric Supply Company, Ltd., that Mr. H. A. Couves, M.I.E.E., has been appointed general manager of that company and the following of its associated companies:—The Cleveland and Durham County Electric Power Company, Cleveland and Durham Electric Power, Ltd., the County of Durham Electric Power Supply Company, County of Durham Electrical Power Distribution Company, Ltd., Houghton-le-Spring and District Electric Lighting Company, Ltd., the Northern Counties Electricity Supply Company, Ltd. Mr. Couves, who joined the Newcastle company some twenty years ago, has occupied the position of chief of the power and construction departments during the greater portion of that period.

COMMERCIAL EDUCATION.—The annual presentation of medals and prizes to the successful candidates in the commercial education examinations of the London Chamber of Commerce will take place, under the presidency of the Lord Mayor (Alderman Sir William R. Pryke, Kt.), at the Mansion House on Friday, February 5th, 1926. In response to the invitation of Lord Southwark, ex-president of the Chamber, and chairman of its Commercial Education Committee, her Grace the Duchess of Atholl, D.B.E. (Parliamentary Secretary to the Board of Education), has consented to present the awards. The proceedings will open at 3 p.m. precisely.

JUNIOR INSTITUTION OF ENGINEERS.—At a meeting of the Junior Institution of Engineers, held on January 1st, six films were shown illustrating some of the work carried out at the River Don Works, Sheffield, of Vickers Ltd. The first three films showed the crucible melting department the tube mill and the bar and sheet mills, and the remainder concerned the manufacture of ordnance, including the production of pig iron and ordnance steel, the casting of ingots, and the forging and machining of a 15in. gun. The films proved of great interest to a large audience. This was the second occasion within about two months that moving pictures had been an item at the Institution's Friday evening meetings.

A NEW METHOD OF MEASURING PRESSURES.—Paper No. 16 of the Safety in Mines Research Board, recently issued, price 6d. net, by H.M. Stationery Office, contains a description by Mr. G. Allsop of a new method of measuring pressures. The pressure gauge described makes use of a thermionic valve, after the manner employed in Mr. H. A. Thomas' device for measuring small movements, which he described and illustrated in our issue of February 9th, 1923, and which he has since applied to the measurement of small pressure differences. Mr. Allsop's apparatus was, we gather, evolved independently for the purpose of determining the mechanical pressure produced when a momentary electric arc is struck inside a closed vessel. The gauge, it is stated, proved satisfactory for that purpose, and also for measuring the development of the pressure produced by gaseous explosions being of particular value when the rate of development is rapid. Details of the work carried out with the gauge are to be given in another paper.

THE MOTOR SHIP PRIMERO.—In our issue of September 18th last we described and illustrated the motor ship Primero, which was built and engined by Burmeister and Wain for the Ivarens Rederi Akts., of Oslo, Norway. She is a 10½-knot cargo vessel of 4400 gross tons, engined with twin-screw six-cylinder motors of the new trunk piston type. Her builders have recently sent us particulars of some of her performances last year. On a voyage to Boston in August the mean fuel consumption for all purposes, including auxiliaries, was 7·4 tons per twenty-four hours, whilst the amount of lubricating oil used for all the machinery worked out at 0·53 gramme, or, say, 0·0011 lb. per indicated horse-power per hour. The same figure for fuel oil consumption was again obtained during a run from New York to Monte Video, on which occasion the lubricating oil consumption was, however, reduced to 0·43 gramme, or 0·0009 lb. per indicated horse-power per hour. In spite of high winds and heavy seas a mean speed of 10·3 knots was maintained on both voyages with the main engines working at a mean speed of 148 revolutions per minute.

THE "O.M.S."—Many of our readers will recall Circular 636, issued by the Ministry of Health on November 20th, which places the burden of making provision in the event of a "state of emergency" being declared, upon the local authorities in each of the areas therein defined. The Circular sets forth what help the central Government proposes to give to the local authorities to supplement and assist in such an emergency the normal methods of communication, supply and distribution, and to give all those who can help the opportunity of doing so in the manner most required. It should be appreciated, however, that under the Government scheme no proper provision is being made for enlistment of volunteers until a state of emergency is declared. The "O.M.S." (Organisation for the Maintenance of Supplies) has been formed, with Lord Hardinge of Penshurst as president, for the purpose of compiling beforehand a classified register of members who would volunteer to assist the Government of the day to the best of their ability in the maintaining of law and order and the essential public services. The head office of the "O.M.S." is 70, St. Stephen's House, S.W. 1 (close to the Embankment entrance to Westminster Underground Station), and here enrolments can be made and further particulars be obtained.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Enter 1926.

INDUSTRIALISTS in the Midlands and Staffordshire heartily welcome the arrival of the year 1926 for though in some directions 1925 showed industrial progress, the iron and steel and heavy engineering industries had a most disappointing twelve months. Just at the end of the year a slight improvement took place in the raw iron and steel departments, and the New Year opened with some prospects of a minor trade revival. Iron and steel masters and engineers are not expecting any trade boom. All they hope for is a steady improvement, greater stability and a lifting of the depression which has clung so tenaciously to the basic industries in the Midlands. If at the end of the year measurable and permanent progress has been made, they will feel quite satisfied. There are undoubted signs which point to the assurance that in this they will not be disappointed. The elaborate programme issued by the London, Midland and Scottish Railway promises liberal orders for iron and steel of various kinds. The local carriage and wagon works are busy, and are expected to be useful customers for the Staffordshire works, while important contracts carried over into the new year for motors, cycles and other typically Midland products, promise expanding demand. Adaptability displayed by the Black Country towards new industries makes it possible to foreshadow a trade improvement which will contrast favourably with the slow progress towards recovery made in that district last year. Motor and wireless trades in Birmingham, Coventry and Wolverhampton are already in a flourishing condition, and thousands of people will find employment at Courtaulds' new artificial silk factory at Wolverhampton. Walsall has put saddlery and harness-making into the background, and taken up new trades, and faces the future confidently. Much is expected of new works in Stafford. General engineering and constructional firms are exceedingly hopeful as to future developments, and there exists in the Midlands and Staffordshire a spirit of optimism which, allied to strong determination to do all in their power to encourage and foster better trade and trading conditions, cannot help but have a beneficial effect on the progress of industrial improvement.

Market Conditions.

Both producers and consumers of iron and steel are giving trade time to develop before committing themselves. The quarterly meeting of the Midland iron trade is expected to produce a large amount of business. By that time work will have settled down, manufacturers will have some idea of their requirements over the first half of the year, and a return to forward contracting is confidently anticipated, especially as everything points at the moment to increased values of iron and steel in the future. There was only a small amount of business transacted on 'Change in Birmingham to-day—Thursday—and that mostly at last week's prices. In the finished iron department, however, there was a fall in values due to the competition from Northern firms.

Bar Iron Prices.

The Staffordshire finished iron works have found it necessary to reduce their prices of wrought iron under the stress of competition from Lancashire, as low as £11 5s. being accepted for medium bars and £10 5s. for nut and bolt and fencing qualities. This is a reduction of fully 5s. per ton on the recently accepted minimum. Best finished iron—marked bars—is in a little better demand. The recent price reduction of 10s. may be partly responsible for this improvement, although there is some evidence of larger needs on account of mechanical engineering. The South Staffordshire situation is considered more hopeful than for some time. With improving orders and prospects, the outlook is brighter, while the increased demand for pig iron suggests that the revival has come at the right end. It is expected that the mills in the district will benefit considerably from the contracts which are being given out by the railway companies. These contracts are a valuable standby in periods of irregular trading conditions, if they do not directly yield high profits. There are latent possibilities in the engineering trades if only prices can be kept at a level which will encourage enterprise. Nearly all the iron and steel-using works of the district have good orders. The wagon-building works are busy and the motor-building trades want a lot of material. The Darlaston nut and bolt industry is a little better employed, and is likely to call for fair quantities of common bars. The continued strike in Charleroi still checks the supply of No. 3 Belgian iron for nut and bolt making, hardly any of this now being obtainable. Staffordshire producers are therefore assuming that some, at any rate, of the orders which have gone in the past to the Continent will find their way to local works.

Pig Iron.

Midland pig irons have not shared in the Northern activity, and very little additional buying has taken place. Foundry grades only are wanted, a fairly good tonnage going regularly into light castings. Recent prices are about maintained. Nothing has yet occurred to justify smelters in re-kindling furnaces which have long been idle. The coke position continues rather uncertain, and at the moment rates incline to firmness. No agreement has yet been arrived at between the coke oven proprietors and the smelters. Some smelters this week asked 1s. to 1s. 6d. more on the strength of the increased cost of coke, but it is doubtful if they got it. Some makes were temporarily withdrawn, presumably to enable producers to get the measure of the New Year's demand and its susceptibility to the upward trend of costs. In this connection, the quarterly meeting is awaited with more than usual interest, for at that gathering a fair estimate of the chances of trade for the first six months of the year may be obtained. Consumers appear to have no anxiety as to supplies, and are operating with much caution, orders being for very small tonnages. It is, however, not overlooked that furnacemen will certainly not be content to pay the extra cost of coke out of their own pockets. The output of many Midland blast-furnaces is pledged to some extent. There are contracts which run into the first two months of the year. Reports of the shortage on Teesside and of inquiries from Lancashire for supplies in substitution of those usually derived from Cleveland have not stimulated the Midland market. Better things are hoped for in the raw iron department for 1926 than proved the case last year when Staffordshire felt the full effect of the trade shrinkage. The number of furnaces in blast at the opening of the year, though one more than a year ago, is only eleven out of sixty. Of the thirty furnaces in the Black Country, the great majority have remained idle throughout the year. At present three are engaged on the production of basic pig, and two small cold-blast plants are in operation. Pig iron has been selling only slowly during the past two months, and although there are a few contracts running into 1926, they amount to very little as a basis for the New Year's trading. At present the outlook is obscure. There are many factors which will influence the expansion or otherwise of trade in this department, chief amongst them, of course, being the cost of blast-furnace coke. Cheap fuel is essential if furnaces are to be run at a profit. At the moment the coke position is very unsatisfactory, no agreement as to a basis price having been reached in this district, and values tend upwards. Until this question is settled, no clear view of the future is to be obtained.

Steel.

In several departments of the steel trade, particularly in plates and sections, price-cutting is as rife as ever. The small measure of success which attended the efforts to stimulate values has not lasted long, and the opinion expressed in many quarters that the big firms were about to return to a remunerative level of prices has, at any rate for the time being, been confounded. Undoubtedly, many steel works selling at present low rates must depend for their return on the extra cost of production upon larger tonnages, which would proportionately reduce the percentages of overhead costs. The amount of business available, however, would not appear to give much chance in this direction for, though there is a fair aggregate of business, orders are small. Angles and joists this week changed hands at figures varying from £7 to £7 5s., with tees 20s. per ton more. Ship, bridge and tank plates were again on offer at £7 15s., but many works wanted 2s. 6d. to 5s. per ton more. Boiler plates command £11 upwards. Small rolled bars vary from £7 15s. to £8, negotiations generally leading to business at a figure midway between the two. Staffordshire hoops are firm at £10 10s. at works. A decidedly hopeful development is the rise in some descriptions of continental steel, amounting to 1s. up to 3s. per ton. The continental works are well situated and unable to give delivery on this side under ten or twelve weeks. The recent advance still leaves most foreign products strongly competitive, and rather large orders have been placed by this district lately for billets, bars, &c. Certain classes of foreign plates are dearer, a matter of importance in view of the large buying abroad, practically throughout the year, of these products. The outlook in the Midland steel trade is improving as the days go by, much being expected from the new works recently announced, and known to be pending. One of the largest local steel works which stopped shortly before the end of last year is now able to keep its steel mills in operation, and, with a fairly promising order book for wrought iron, may be able to restart that department shortly.

Galvanised Sheets.

Galvanised sheets have not been selling freely lately, and though the standard for 24 gauge corrugateds remains at £16 12s. 6d., rather more business has been done below this figure. Buyers with good contracts to place have no difficulty in getting supplies at £16 10s. The works, however, have satisfactory order books, and the local mills producing this material were amongst the first to resume after the holidays.

Electrical Additions at Sutton Coldfield.

Owing to the rapidly increasing demand for electricity at Sutton Coldfield, Birmingham, the borough Electricity Committee has approved a scheme for the improvement and alteration of the plant, and proposes to ask the sanction of the Electricity Commissioners to the borrowing of £28,650 for the purpose of carrying out the work.

Cannock Chase Miners' Wages.

For the seventh successive month, Cannock Chase miners' wages during January will be based on the minimum rate of pay under the National Wages Agreement. The minimum for stallmen, therefore, will be 9s. 8d. a shift, compared with 10s. in January last year and 10s. 3d. in January, 1924.

New Steel Railway Wagon.

A new type of steel railway wagon is being built by the Butterley Company, Ltd., at its works at Codnor Park, Notts. This wagon is a direct development of a pit tub, designed by the company, of which large numbers are in use. The side and end plates of the tub consist of separate steel sheets, each of which is strengthened along its upper edge by the plate being rolled upon itself in a flat roll, three or even four times, something like a tinman's joint, according to the thickness of the plate to form a stiffening belt. This belt takes the place of the usual separate external band, which requires a number of rivets to secure it to the body plates. Similarly, the body plates are flanged along their vertical edges to form corner joints, the end plates being further bent round to take the side plates. The corner joints thus made out of the actual body plates, form a four-fold column of steel from top to bottom of the tub at each corner where strength is most needed. The steel wagon referred to is constructed on similar lines to the steel tubs, including the sliding flanged corner joints, and the top roll in the side plates. Rolls are introduced in all other parts of the wagon requiring special strength, such as the edge of the bottom plate at the door end, the sills of the side doors upon which the doors are hung, &c. &c. The first of these wagons, a 12-ton mineral wagon, to be built, has been passed and registered by the London, Midland and Scottish Railway Company. It has been put through the most severe tests, with excellent results, and is now working in main line traffic.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

ALTHOUGH only a small business is passing in the Manchester iron and metal markets this week, there is a decidedly more hopeful feeling in the trade as to the future. It is thought that the period of unprofitable working is at last coming to an end, and although there is a difference of opinion as to the probable course of prices, it is beginning to be realised, even by consumers here, that there is not much probability of any further fall in prices. Last year the fall was almost continuous from January to October, and the slight improvement in October and November was lost early in December. The main reason why anyone is doubtful now about the prospects of the New Year is the impending crisis in the coal trade; and if that can be averted, there is every reason to hope that some progress may be made towards a better industrial situation. We have yet to wait some time for the report of the Coal Commission, which should throw some light on the chances of avoiding a great labour disturbance in the late spring, but despondency regarding this matter is not so prevalent as it was.

Metals.

With the one exception of copper the non-ferrous metal market is not in a bad condition. Of course, little new buying is in evidence yet, but that is not to be expected until towards the middle of the month, when consumers will begin to think about securing their requirements for the early spring. Local consumption of non-ferrous metals is, however, expected to improve, as there seems to be some stirring in the engineering industry of Lancashire. Lower prices for manufactured metals, especially for copper sheets and tubes and for locomotive brass tubes, would be a help to the engineering industry. Standard copper is now at prices which scarcely admit of any further reduction; and the market has reached the present level mainly because of the inability of Germany to buy her fair share of metal. If the finances of that country can be restored to normality there would be every reason to expect a recovery in standard and refined copper prices, for American consumption of copper remains good, and British consumption is tending to improve. No doubt the output of copper is large, but there is no reason to think that the industries of the world are incapable of absorbing it all if they were brought back to ordinary activity. In electrical work alone there is scope for a great expansion of copper consumption. In the Manchester district dealers in scrap non-ferrous metals continue to offer only low prices for old copper and gun-metal. For clean collected old copper they are paying £56 per ton, and for ordinary lots of gun-metal £46. These metals ought therefore to be available for the engineers who can use them at very moderate rates. The old gun-metal especially is very cheap, for even the commonest metal of this class must be worth, intrinsically at least, £60 to £62 per ton. The market for lead is steadier again, and possibly the fall in prices is over. Lead, of course, is still fairly high, as compared with copper, but so are all the other metals; and the consumption of lead has increased enormously, so that no comparison can be made with pre-war conditions. In the market for spelter there has been a slight reaction from the highest prices, but mainly in sympathy with the other markets. The general position in the spelter market seems to be fairly sound; but, of course, the price now is rather on the high side. If spelter should go over £40 per ton, the price may cause a check to consumption for a time.

Pig Iron.

The market here for foundry iron is in a more cheerful mood, and it seems quite likely that when active business is resumed, sellers will be able to enforce a small advance in price. The temporary scarcity of iron in the Cleveland district has led to a much stronger market there, and, of course, this is not without its influence on Manchester. It is possible that the rise in Cleveland iron will induce some consumers to act before the Birmingham meeting, and there is talk now of putting the price of Derbyshire No. 3 up to 75s. per ton delivered here. Up to the end of the year it was comparatively easy to buy Derbyshire here at 73s. 6d. per ton, and Lincolnshire at 72s. 6d., but this week sellers are not satisfied with these prices. It is doubtful whether the small advance to 75s. would induce ironmasters to add to the number of active furnaces; but if substantial contracts can be placed, so as to secure an outlet for the production of new furnaces, some of the idle plant may be put into operation. The mere possibility of such being the case is probably sufficient to check any serious rise in pig iron prices, and hence consumers need not become too anxious as to the future; but it seems likely that we have now witnessed the bottom of the depression, and that pig iron will not again be so cheap as it was in the last quarter of the year. There is some improvement observable in the general foundry trade, and a prospect of a larger consumption during the spring; but foundry business cannot yet be described as prosperous. There is very little iron other than Derbyshire and Lincolnshire being offered in this district. Northamptonshire has been out of the market for some time, and only a little Staffordshire comes here. The higher

price of Cleveland iron also tends to extend the range of the market for Derbyshire iron, which can now go farther North than before. In Scotch iron there is little change, but some inquiries are about, and it is expected that a bigger demand from the textile machinery industry will soon be seen.

Finished Material.

There is little sign of improvement in the demand here for Lancashire iron, and the high prices continue to encourage imports of the cheap continental makes. Now that the expectation of assistance under the Safeguarding Acts is at an end, one may perhaps hope that efforts will be made to reduce costs and to supply Lancashire iron at more competitive prices. In steel there is a decidedly better feeling, and it seems quite possible that rather more remunerative prices may be established in the spring. About £8 per ton is quoted here for common plates and £7 5s. per ton for joists and angles; but foreign steel can be bought at fully £1 per ton below these figures.

Scrap.

The market here for old iron and steel is very quiet still, and not much business is moving yet; but the feeling is more cheerful. A larger demand is expected by dealers for steel scrap, although it is doubtful whether prices can be raised much, if at all. Dearer pig iron may probably lead to some improvement in the cast scrap market. Dealers have been selling good broken machinery at 70s. per ton, but they are less inclined now to accept business at that figure. For special "textile" cast scrap up to 75s. per ton is asked. The demand for heavy wrought scrap is not very large, as no very great quantity of Lancashire iron can be sold at the present prices; but dealers seem inclined to believe that wrought scrap will appreciate to a certain extent during the present quarter.

Salford Electricity Supply.

The demand for electrical energy is growing apace in this district. This week the Salford Council is considering the recommendation of its Electricity Committee that the Electricity Commissioners should be asked to sanction the borrowing of the sum of £132,330 to cover the cost of mains and service cables, and the erection and equipment of sub-stations. About £90,000 of the total will be expended on new mains, and it is anticipated that that will meet the requirements of the users for the next three years; and £24,000 is to be set aside for new plant for the Frederick-road Station, for a rotary converter in connection with the 33,000-volt supply from Agecroft. Another transformer is to be provided at Irlams-o-th'Height.

BARROW-IN-FURNESS.

Hematite.

During the past week or two there has been a slight increase or accumulation of stocks, but this must not be taken as a sign of an easing in the pig iron market. The accumulation has mostly been due to the fact that the steel departments have been idle during the holidays. These stocks will not remain long on makers' hands with the business developing as it is. One of the best signs is that many customers have placed orders to meet their requirements during the next month or two, and there is a distinct inclination on the part of some to cover for further periods. With the improvement in the engineering trades consequent upon the placing of contracts—the London, Midland and Scottish orders, for example—there is bound to be a better all round inquiry. Many customers who last year bought from hand to mouth are placing orders with more confidence and for bigger tonnages. The continental trade is not brisk for obvious reasons, but parcels of pig iron are going out at intervals, although the shipments are not heavy. The American trade fluctuates but still accounts for some purchases of special classes of iron and more shipments are probable. There is a better inquiry for special qualities of iron, especially manganese, as compared with a few months ago.

Iron Ore.

The iron ore trade is slightly improved, and more orders are being delivered outside the district. A few months ago little if any native ore was being delivered except to local users. As the general trade improves business with Scotch and North-East makers will increase. Foreign ore is in fair demand, and the request for it is likely to improve as new furnaces go in in the district.

Steel.

There is just a little more confidence in the steel trade, and more orders are available, although the competition continues to be keen. It is hoped that contracts will be booked which will help to keep the local rail mills going. Workington restarts next week in the rail and sleeper departments, but has not orders to keep the works going all the month. Barrow holds a few orders, and there are hopes of more coming to hand for rails. The hoop and small section mills are fairly well off for orders.

Shipbuilding and Engineering.

There are several rumours of shipbuilding orders for Barrow, but up to the present nothing official has been revealed. All that can be said at the moment is that the prospect in the shipbuilding trade is slightly better, and the chance of some contracts being received is not exactly remote. As far as engineering is concerned the big works are not so badly situated in view of the recent Admiralty contracts for gun mountings, &c. There are likely to be further developments in the course of a month or two.

SHEFFIELD.

(From our own Correspondent.)

A Quiet Opening.

On the heavy side of the steel trade the New Year has opened quietly. The resumption of work after the holiday break was on about the same scale as before, and, although the outlook for the future is considered favourable, there is no actual improvement to record at present. The melting plant in operation at the local works of the United Steel Companies consists of eight of the fourteen open hearth furnaces at Templeborough and five at Rotherham, or about half the total number. An indication of the feeling with regard to the future is afforded by the fact that the market for scrap is firmer, the price of heavy steel having risen to 65s. per ton. There has also been a hardening in hematite and ordinary pig iron, and there is an upward tendency in quotations for blast-furnace coke. The New Year has not brought any changes in local steel prices, but those now ruling are regarded by sellers as being the minimum.

A Large Railway Order.

In the absence of any improvement in the shipbuilding demand, the manufactured side of the heavy steel industry will still have to depend largely on the work which comes forward from the railway companies. The amount of such work which was placed last year fell short of expectations, and it remains to be seen whether the large programmes that have recently been announced will produce greater activity during the coming twelve months. The orders from British companies, large though they may be, are not sufficient to provide full employment for the great axle, tire and spring plants of Sheffield. Business from overseas is also required, and a large amount of that business is being placed on the Continent, which is able to quote prices much below those of Sheffield. However, the New Year has already brought one welcome overseas order to a company associated with a Sheffield firm. The Leeds Forge Company, which is a subsidiary of Cammell Laird and Co., Ltd., has received from the High Commissioner for South Africa an order for 500 all-steel bogie covered wagons, each of 40 tons capacity. These wagons are for the conveyance in bulk of grain from the farming districts to the South African ports, and are specially designed to suit the elevator system recently installed at the main up-country stations and at the ports of Capetown and Durban. The Leeds Forge Company has also received an order from the High Commissioner for seventy all-steel bogie hopper coal wagons, similar in type to a number already supplied.

The Lighter Trades.

Several of the hand tool trades showed some falling off in activity during the last quarter of 1925, but the prospects are considered fairly good. As is usual at the beginning of the year, numerous foreign inquiries are afoot for mechanics' and engineers' small tools, but it does not follow that many of them will result in actual business. Good employment is provided by the machine knife trade, especially in connection with the wood-working industry. Mixed conditions are reported in the twist drill, spanner and cutter sections, where several firms are busy, while the others are very quiet. The file trade continues well employed. In saws, although the aggregate output is considerable, activity is not altogether general, and the state of the trade as a whole is not as good as it was six months ago.

Cutlery and Plate.

There is no change to report in the condition of the cutlery and plate branches, which are, on the whole, only moderately employed. The production of stainless steel table knives, although still on a large scale, is much below the level which it had maintained for three or four years until it fell off about the middle of 1925. Several of the makers of high-class pen and pocket knives are fairly well placed, but the cheaper classes of trade are still handicapped by German competition, which has latterly been more severe than before, in anticipation of the import duty that is now in operation. On the electro-plate side, the demand for spoons and forks is fair, though considerably below the normal, while trade in best quality hollow-ware is very quiet. A rapidly growing industry in Sheffield is the production of safety razor blades. Something like a dozen firms are now engaged in the trade, and the city's products have gained a high reputation. Darwin and Milner, Ltd., who acquired the 6-acre works of the Sheffield-Simplex Motor Company rather more than a year ago, are equipping themselves for the manufacture of blades on an enormous scale. They have already made much progress, and are turning out upwards of a million blades per week. All the work, from the making of the material—cobalt steel—to the finishing of the blades, is done on the premises, mostly by girls, of whom 750 are at work in one shop, covering an acre, where the processes of rough grinding, polishing, stropping and finishing are carried on. The firm is greatly extending its resources, and expects that by May next it will have an output of a million blades a day, and that its employees will then number some 3000, as compared with a present total of 1300. It recently had an inquiry from America for one hundred million blades, to be supplied in one year.

Colliery Economies.

Some interesting statements, with regard to measures recently taken to secure economy and efficiency were made at a staff dinner of the Denaby and Cadeby Main collieries, near Doncaster, last Saturday. Major J. Leslie, D.S.O., M.C., the chairman and managing director of the company, said that at Denaby they had recently accomplished a great engineering feat, probably the greatest of its kind in England, and they wanted to push forward improvements every year. He did not think it was an exaggeration to say that they would probably have had to close the Barnsley seam at Denaby if they had not sunk a shaft which had enabled them to reduce running costs to such a point that they could carry on. Denaby was an old pit, and the work was done just in the nick of time. Another speaker, Mr. T. Hill, said that if every colliery company would take the steps which had been taken at Denaby, he did not think the nation would be in the state it was in to-day. The substitution of iron for wooden tubs had increased output by about 1500 tons a week.

Coalfield Drainage.

The possibility of a serious situation, arising from subsidence, confronts those who are responsible for the drainage of the Doncaster coal area. The matter is referred to as serious and urgent in the first report of the Royal Commission on Mining Subsidence, which has been issued as a White Paper. The total area is some 200,000 acres, mainly situate in the West Riding, but including parts of Lindsey and Notts., and it contains a great virgin coalfield, the actual limits and ultimate resources of which cannot yet be stated with any finality. The soil of the district is for the most part of rich quality, with its surface already below the level of the rivers, and only preserved for agricultural purposes by an elaborate system of drains and pumping stations. It has been calculated by Mr. Joseph Humble, M. Inst. C.E., that the extraction of the minerals will ultimately involve a fall in surface levels of 21ft. Some of the witnesses called before the Commission apprehended that, long before that point was reached the existing system of drainage would be rendered entirely useless, and the surface would become either waterlogged or converted into a great lake. The report points out that the development of the coalfield is at present in a very early stage. Accordingly, there is still time to consider and treat as a whole the problem it presents, subject perhaps to one reservation. The coalfield is being developed from west to east, and the flow of the drains is in the same direction. The fact must therefore be faced that the working is from the wrong end, so far as the welfare of the drainage system is concerned. A further complication is introduced by the fact that geologists have not yet determined the eastern boundary of the coalfield, and an effective scheme of drainage will largely depend upon whether the workable coal stops short of the river Trent, or whether it extends beyond that line. The report suggests that a Commission, with expert advisers, should be set up immediately to deal with the problem.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THE optimistic feeling regarding the prospects for 1926, which became pronounced before the Christmas holidays, still prevails. Business, of course, has scarcely got into its stride yet after the holidays, but the position of the trade is entirely healthy, there is a confident feeling abroad, and makers are so comfortably off for orders over the next few weeks that some of them are quoting 6d. above the minimum prices for Cleveland iron. The home industrial requirements have undergone considerable expansion of late, and seem likely to absorb the bulk of a limited output. It is the foreign trade which is slack, and although recent price advances have been wholly absorbed by the rise in the cost of fuel, these advances have tended further to restrict foreign business. There are thus very few export sales, but happily ironmasters are less dependent upon the export market, and are in a position to hold out for the full amount of the agreed minima, which are:—No. 1 Cleveland, 71s.; No. 3 G.M.B., 68s. 6d.; No. 4 foundry, 67s. 6d.; No. 4 forge, 66s. 6d.; mottled and white, 66s. These are home prices, and 6d. per ton extra is charged for export orders.

Hematite Pig Iron.

There is little change in the East Coast hematite pig iron trade. Makers are beginning to overtake the arrears in deliveries, but there is still some leeway to be made up. Demand has naturally been less brisk over the holidays, but makers are well situated, with plenty of orders for execution, and the price is kept steady at 77s. per ton for mixed numbers and 77s. 6d. for No. 1.

Ironmaking Materials.

Heavy imports of foreign ore are expected this month, and consumers are therefore under no necessity to come on to the market for fresh supplies. Best Rubio ore accordingly remains steady at 21s. 6d. per ton c.i.f. Tees. The coke trade is quiet. Consumers have fairly well covered immediate requirements, so that there is no pressing demand. Sellers, however, are by no means eager, and the price of good medium furnace kinds is steady at 22s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

The prospects in the manufactured iron and steel trade are regarded as more hopeful, but there is still room for a big improvement before all the plant in this district is fully employed. Prices of steel ship plates, joists and angles, which have been continuously falling for two years past, were advanced on Wednesday by 2s. 6d. per ton by North-East Coast makers. The new quotations are:—Steel ship plates, £7 7s. 6d.; joists, £7; and angles, £7 per ton.

The Coal Trade.

Although business in the Northern coal trade is not particularly heavy just now, the position is very encouraging. Collieries have a good deal of work on hand, and with inquiries numerous and large hope is entertained that substantial orders will mature. In the Northumberland steam coal section there is a continued good inquiry, but business matures slowly. Prices all round remain at recent levels, and 15s. 3d. to 16s. 6d. for best and 14s. 9d. for Tyne primes are about the lowest figures acceptable to sellers for prompt shipments, and are generally asked forward. Secondary classes of steams are quiet, but maintain 14s. 3d. to 14s. 6d. Steam smalls are in the main nominal, but fitters are in a steady position and quote 9s. 6d. for best, 8s. 6d. for seconds, and 9s. 9d. for special favourite kinds. A favourable January outlook can be recorded with regard to Durham coals. Prompt turns are very full and there is a fairly substantial inquiry. Business just now, however, improves but slowly, and prices remain unchanged. Best gas coals are firm at the well maintained

figure of 16s. 6d.; seconds keep fully to 15s. 3d. to 15s. 6d.; and Wear specials are 17s. to 17s. 6d. There is not a great amount of Durham steams on offer, and 17s. 6d. to 18s. is realisable. Coke business is largely held up by the effect of the recent holidays, and few transactions are heard of just at present. There is plenty of demand, and sellers ask full late figures. Gas makes are at 24s. to 25s.; patent foundry sorts at 22s. to 24s.; and beehive kinds at 30s. to 32s.

Iron and Steel Exports in 1925.

The iron and steel export trade from the Cleveland district during 1925 showed a marked contraction upon that of 1924, and in the aggregate fell just short of one million tons. Just about double that tonnage was exported from the district in 1913, but the decline was almost entirely confined to pig iron exports. The 1925 exports of manufactured iron and steel totalled 627,379 tons, of which 178,340 tons went coastwise and 449,039 tons to foreign ports, as compared with a total of 647,280 tons in 1924, and 1,967,617 tons in 1913. Pig iron shipments, however, which totalled 1,246,884 tons in 1913 and 442,554 tons in 1924, showed a considerable decline to 371,666 tons, of which 168,764 tons went coastwise and 202,902 tons to foreign ports. Cleveland has not yet reached the stage of complete independence of the foreign markets for pig iron. There is still a surplus output for disposal abroad, and the district will no doubt continue to export for years to come. But the trend of events is unmistakable. The district is never again likely to approach an export of a million tons of pig iron, because more and more is being utilised in the local steel furnaces. Only once during the year did the exports exceed 100,000 tons, the maximum of 100,985 tons being touched in October, whilst the minimum was in May, when 72,855 tons were shipped. The tonnage of 371,666 tons of pig iron shipped from the district during 1925 is the smallest annual figure since 1921. Proportionately, more iron was shipped coastwise, and less to foreign ports. Both Belgium and Germany, for example, took about half the quantity of pig iron that they did in 1924. To France the proportion was considerably less than half, and the only countries to take an increased tonnage were the United States and Italy. The possibilities of a further development of the American trade are by no means remote. Already contracts fixed ensure the dispatch of a big tonnage this year, and if other negotiations mature, as seems likely, a good trade is promised. In the home trade the decline in the shipments to Wales is most noticeable, having fallen from 32,888 tons to about one-fourth that total, whereas to Scotland the shipments have increased. An interesting point in connection with the manufactured iron and steel exports is the fairly heavy trade with India, in spite of the tariff wall. About 130,000 tons were exported to that country, as compared with 162,000 tons in 1924. To Australia and New Zealand a smaller tonnage was shipped, but nearly twice the quantity of steel was dispatched to South and East Africa. On the other hand, there was a very marked decline in the trade with the Far East, particularly China and Japan. On the whole, the trend was towards an expansion of trade with British Dominions, and that is a movement which it is desirable to foster.

The Coal Subsidy Scheme.

The accountants have just issued their report regarding the proceeds and costs in the coal mining industry of Northumberland for September, October, and November. The figures arrived at would have governed wages in January if there had been no subsidy to maintain wages at the level of 100 per cent. on base rates, as provided by the National Agreement of 1924. The report shows that the percentage on basis rates would have been 26.88 per cent., as compared with 24.53 in December, an increase of 2.35 per cent. The difference between 26.88 per cent., which is the economic yield of the industry, and the 100 per cent. minimum, is, therefore, 73.12 per cent., and has to be provided out of the subsidy.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding in 1925.

So far as actual figures are concerned, the returns for 1925 amount to 280 vessels of 523,322 tons aggregate, which represents an increase of 29 in the number of vessels launched, but a decrease of about 15,000 tons in the aggregate tonnage, compared with the preceding year. It may be said right away that these figures present an erroneous idea of the state of the industry. While the output was fairly well up to the average, the number of fresh contracts was distinctly meagre, and the outlook became less promising as time went on. As new vessels left the stocks the berths vacated became greater in number and employment became less and less. Shipowners were not inclined to consider new tonnage at the present cost of construction, and new contracts dwindled away to almost nothing. At the moment there are no liners on the stocks, and no immediate prospect of any contracts for such craft. The largest vessel built on the Clyde during 1925 was the Conte Biancamano, 23,281 tons, built by William Beardmore and Co., Ltd. The decrease in shipbuilding at home and the increasing construction abroad gives ample proof of the menace of high costs of production. There have been instances of owners cutting the loss in order to place their order for new ships with home builders. Few owners, however, are in a position to do this, and contracts therefore are going abroad in increasing numbers.

Pig Iron.

The past week has been an idle one, owing to the New Year holidays. At the close of 1925 there were only some thirteen furnaces in blast, compared with eighteen in January, 1925, and about eighty in normal times. In January, 1925, makers were confident that business would expand and that additional furnaces would have to be put into commission to cope with the demand. The reverse has been the case, however, and throughout the year there was a steady decline in demand and the prices obtainable. Best foundry pig iron was quoted about 95s. per ton twelve months ago, while cheaper qualities were about 90s. per ton. The current rates are 80s. and 77s. per ton respectively. Similarly, hematite has dropped from 95s. to 77s. 6d. per ton in the same period. Competition from English and continental makers has been pretty acute, while cargoes from India have been sold here at prices considerably under home quotations. Nothing has occurred to indicate any early change for the better.

Steel and Iron.

The Scottish steel and iron trades have passed through a very anxious year, and it is sincerely hoped that 1926 will be more productive. Everything possible was done to stimulate business, the costs of production having been cut down as far as possible, and prices submitted that could leave only a very small percentage of profit, if any. The demand for shipbuilding material has been especially disappointing, and plates and sections have experienced a very lean time. Heavy steel sheets have not been very successful, but the lighter gauges have had little difficulty in securing sufficient orders to maintain full employment. Galvanised descriptions have been especially active. The "freeing" of steel prices has resulted in keen competition and a steady decline in values, to-day's quotations showing a drop of £2 per ton in plates and sections and about £3 10s. per ton in sheets under ¼in. to 3/16in. Light sheets are firm at £11 15s. per ton for 24 gauge, while galvanised flat or corrugated sheets are very strong at £18 per ton f.o.b. Glasgow. Bar iron has had a comparatively poor year, despite all efforts to maintain the turnover. Reductions in price have proved of small benefit, as many consumers preferred to substitute steel, owing to the cheaper cost of the latter. Bar iron at £11 5s. per ton is 15s. per ton cheaper than in January, 1925.

Coal.

Business in the coal market has been at a standstill, owing to the fact that the collieries continue on holiday. In the absence of business prices have not been tested, and are purely nominal. Orders in hand for delivery this month are comparatively small in bulk, and there is every indication that consumers will maintain their present policy of buying only against immediate requirements. Aggregate shipments for 1925 amounted to 12,315,434 tons, showing a decrease of 910,640 tons compared with 1924 and 4,277,060 tons compared with 1913. The returns for the year 1913 constituted a record in shipments.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

ALTHOUGH there is no doubt that a good deal of business has been arranged in some of the leading qualities of steam coal for delivery over the first quarter of this year, still 1926 has not opened quite as favourably as was expected. This is due in a very large measure to the fact that the weather conditions have been so bad as to drive out of position the bulk of tonnage which had been arranged for loading in this district during the early part of this month. It has been a rather serious matter for some of the collieries, as it has weakened their position in quoting for fresh business. The absence of ready tonnage has compelled many of them to take reduced prices from those buyers who happened to be able to load immediately, but there are expectations that the second half of the month will be better, as by that time a considerable quantity of the delayed tonnage should be at the disposal of the collieries. The demand for coals for Italy is a little more active, and the Portuguese Railways are in the market for 15,000 tons of Admiralty large coals for shipment this month and next, while there is a further demand for Admiralty coals amounting to about 100,000 tons for Brazil for shipment during February and March. In the case of the order from the Navagazione Generale Italiana for 90,000 tons of Admiralty large coals for shipment from January to May, it is reported that this business has been taken by Lysberg, Ltd., and the Maris Export and Trading Company, Ltd. It is also understood that the London, Midland and Scottish Railway has placed contracts for Monmouthshire coals for delivery over the current year. The report is current that the Greek Railways have contracted for the supply of 400,000 tons of Welsh coal, delivery over five years at the rate of 80,000 tons per annum, but of this confirmation locally is not forthcoming.

Loading Conditions.

Last week the members of the local Shipowners' Association received a visit from Sir Felix Pole, the general manager of the Great Western Railway Company, who is manifesting a very real interest in the question of the improvement of the loading conditions prevailing at South Wales ports. For a long time there has been considerable complaint on the part of shipowners at the delay experienced by their tonnage when fixed for loading in this channel, and the desire of everyone concerned with the export of coal is that an improvement should be effected so that South Wales can regain its name for quick despatch. One of the suggestions put forward by Sir Felix Pole was that there should be a withdrawal or modification of the loading hours provided for in the South Wales coal contract form, and for a re-arrangement in the working hours for the shipment of coal. His contention was that there was no reasonable justification for continuing the present long loading hours, in view of the great improvement in the shipping facilities, and he made the suggestion that so long as the volume of trade could be dealt with in sixteen hours, it would be more beneficial if those hours of working could be split up and spread over the twenty-four hours. He was convinced that a day and night shift with a break would be the most advantageous to all concerned. Naturally the suggestions put forward by Sir Felix Pole have come in for a good deal of attention, and hopes are expressed that something of a tangible character will be the outcome. The majority of the shipowners favour the proposal of a day and night shift with an interval between them, as that would enable the docks' officials to organise the traffic to advantage and there would be greater provision of coals, so as to enable vessels to maintain continuous loading. No doubt the majority of those interested in the coal trade will hold the view that the proper solution of the whole question is to return to the conditions of working all round the clock, but in the absence of that, two shifts with a break between them are regarded as preferable to the existing system. An alteration means, however, securing the co-operation of the trimmers, and it is here that the chief difficulty rests. These men are not directly employed by anyone; they are practically their own masters and recognise their own union only. There are about 1700 of them in this district. Their earnings on a tonnage basis are pooled, which robs the men individually of the incentive of working harder, as they do not directly get the benefit of their extra exertions.

Ship-repairing Items.

The ship-repairing industry in this district has suffered to an appreciable extent by tonnage not arriving to time on account of the bad weather, but vessels which have docked lately are in many cases requiring attention, for the reason that they have sustained damage by the storms. One fairly good order has, however, been lost to this district, notwithstanding the fact that the steamer, the ss. Havur, was actually lying at Port Talbot. The contract, amounting to between £7000 and £8000, has been obtained by the Wilton Shipbuilding and Ship-repairing Company, at Rotterdam, where the work will be carried out. Extraordinary meetings of shareholders in the Mountstuart Dry Docks and Shearmans, Ltd., have approved resolutions to carry into effect the amalgamation of the undertaking of Messrs. Elliot and Jeffery, and to reorganise the capital of the Mountstuart firm. Mr. John Elliot has been appointed the managing director of Mountstuart Dry Docks and Shearmans, Ltd., and after the confirmatory meeting of shareholders will be elected the chairman of the company in succession to Mr. Frank Shearman.

Reopening Pits.

Arrangements were made for the reopening this week of work at the Nos. 1 and 4 pits at Ferndale, belonging to D. Davis and Sons, Ltd. These pits have been closed for the past two months on account of the trade depression. There is also the prospect in a few weeks' time that a restart will be made at the Tynewydd Colliery, Pontlottyn, where a new electric winder is being installed. Over 1000 men were employed before this pit was closed. It is reported that a new rich vein of coal has been struck in the Bargoed Steam Coal Colliery, at which work was stopped some months ago. Between 800 and 900 men have been re-employed, and it is hoped shortly that the full number of men will be re-engaged.

Margam Copper Works.

The Briton Ferry Steel Company, Ltd., has acquired the old Margam Copper Works at Port Talbot, which have been idle for some months past.

Tin-plate Trade.

The men's side have decided to give the Joint Industrial Council of the South Wales tin-plate trade three months' notice to terminate the existing sliding scale agreement, so that the matter will be brought up at the next annual meeting in May.

Current Business.

The tone of the steam coal market is temporarily quiet, owing to the inadequacy of ready tonnage. There is, however, a fairly considerable quantity of tonnage due to come along to load as chartering has recently been more active. Brisker conditions are expected to prevail towards the middle of the month, but at the moment market conditions are rather irregular, and small coals are relatively easier than large qualities. Anthracite descriptions continue to be very steady. Patent fuel and coke display no alteration of note.

CONTRACTS.

ALLOY WELDING PROCESSES, Ltd., of 14–16, Church-street, Islington, London, N. 1, informs us that it has secured a contract through H.M. India Office for the supply of three two-operator motor generator electric arc-welding plants, for the Eastern Bengal Railway.

MELDRUMS, Ltd., of Timperley, near Manchester, have received an order to supply a complete refuse destructor installation for the city of Caracas, Venezuela. This installation, which will deal with 100 tons of refuse per day and provide steam for the generation of electricity, will consist of two independent plants, each consisting of a four-grate "Meldrum" Simplex destructor, with water-tube boiler, regenerator, chimney and containing building.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has recently obtained the following contracts:—For the twelve months' supply of Mazda vacuum and gas-filled train lighting lamps to the Great Northern section of the London and North-Eastern Railway; for the twelve months' supply of Mazda lamps to the Dublin United Tramways; for the supply of Mazda lamps during 1926 to the Aberdeen Line; and also a six months' contract for the supply of Mazda lamps to the Great Northern Railway Company (Ireland).

THE LEEDS FORGE COMPANY, Ltd., Leeds, has received an order from the High Commissioner for South Africa for 500 all-steel bogie covered wagons, each of 40 tons capacity. These wagons are for the conveyance of grain in bulk from the farming districts to South African ports, and are specially designed to suit the elevator system recently installed at the main up-country stations and at the ports of Capetown and Durban. In addition to the foregoing, the company has also received from the High Commissioner an order for seventy all-steel bogie hopper coal wagons of the same type as some previously supplied.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	21/-
(1) Spanish	18/6
(1)N. African	18/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 6	—
No. 1 Foundry	3 19 6 to 4 1 6	
No. 3 Foundry	3 16 6 to 3 19 0	
N.E. COAST—		
Hematite Mixed Nos.	3 17 0	3 17 0
No. 1	3 17 6	3 17 6
Cleveland—		
No. 1	3 11 0	3 11 6
Silicious Iron	3 11 0	3 11 6
No. 3 G.M.B.	3 8 6	3 9 0
No. 4 Foundry	3 7 6	3 8 0
No. 4 Forge	3 6 6	3 7 0
Mottled	3 6 0	3 6 6
White	3 6 0	3 6 6
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 2 0 to 3 2 6	
,, Forge	2 15 0 to 2 16 0	
(3) Derbyshire—		
No. 3 Foundry	3 5 0 to 3 6 0	
Forge	3 1 0 to 3 2 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 10 0 (a) / 4 12 6 (b) / 4 17 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	—
Best ,,	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	11 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 5 0 to 12 0 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 11 0 0	
Gas Tube Strip	12 10 0 to 12 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ¼in. and up.	7 10 0 to 7 12 6	
Sections	7 0 0 to 7 2 6	
Steel Sheets, under 3/16in. to ¼in.	9 2 6 to 9 5 0	
Sheets (Gal. Cor. 24 B.G.)	—	18 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 7 6	—
Angles	7 0 0	—
Boiler Plates	11 10 0	—
Joists	7 0 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light ,,	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
MANCHESTER—		
Bars (Round)	8 5 0 to 8 10 0	
,, (others)	8 0 0 to 8 5 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	7 17 6 to 8 5 0	
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0 to 11 0 0	
MIDLANDS—		
Small Rolled Bars	7 17 6 to 8 0 0	
Billets and Sheet Bars	6 2 0 to 6 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 12 6 to 16 15 0	
Angles	7 2 6 to 7 5 0	
Joists	7 2 6 to 7 5 0	
Tees	8 2 6 to 8 5 0	
Bridge and Tank Plates	7 15 0 to 8 0 0	
Boiler Plates	11 0 0 to 12 0 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	288 0 0
,, (three months)	281 7 6
Copper (cash)	59 15 0
,, (three months)	60 15 0
Spanish Lead (cash)	35 8 9
,, (three months)	35 1 3
Spelter (cash)	38 18 9
,, (three months)	38 0 0
MANCHESTER—	
Copper, Best Selected Ingots	65 10 0
,, Electrolytic	67 5 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
,, Condenser	0 1 2½
Lead, English	37 0 0
,, Foreign	36 0 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11 to 2/- per lb.	
Ferro Tungsten	1/8 to 1/9 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 0 0	7/9
,, 8 p.c. to 10 p.c. ,,	£22 7 6	7/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£40 10 0	14/-
,, ,, 1 p.c. ,,	£49 0 0	16/-
,, ,, 0·70 p.c. carbon	£56 10 0	17/6
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	3/6 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0	scale 5/- per unit
,, ,, 75 p.c.	£21 10 0	scale 6/- per unit
,, Vanadium	15/3 per lb.	
,, Molybdenum	6/1 per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£172 to £177	
Cobalt	10/- per lb.	
Aluminium (per ton)	£120	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	18/-
,, ,, Ell	17/6
,, ,, Splint	19/- to 20/6
,, ,, Trebles	18/-
,, ,, Doubles	17/-
,, ,, Singles	14/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	16/-
,, ,, Splints	19/-
,, ,, Trebles	18/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/3 to 15/6
Screened Navigation	21/-
Trebles	18/6 to 19/6
Doubles	17/3
Singles	15/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/4½
Secondary Steam	14/9
Trebles	18/4½
Doubles	16/9
Singles	14/9

ENGLAND.

(8) N.W. COAST—	
Steams	23/6
Household	40/- to 45/-
Coke	26/-
NORTHUMBERLAND—	
Best Steams	15/6
Second Steams	14/6
Steam Smalls	9/6
Unscreened	14/-
Household	20/- to 22/-
DURHAM—	
Best Gas	16/- to 16/6
Second	15/6
Household	20/- to 22/-
Foundry Coke	22/- to 24/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	31/- to 34/-
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	26/- to 27/6 —
,, ,, House	24/- to 25/- —
,, ,, Large Nuts	17/- to 20/- —
,, ,, Small	12/6 to 14/- —
Yorkshire Hards	16/6 to 19/6 —
Derbyshire ,,	16/- to 19/- —
Rough Slacks	10/- to 12/6 —
Nutty ,,	7/6 to 9/- —
Smalls	3/6 to 6/- —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 19/3 to 19/9

CARDIFF— (9) SOUTH WALES.

Steam Coals:	
Best Smokeless Large	22/6 to 23/-
Second ,, ,,	21/6 to 22/-
Best Dry Large	21/6 to 22/-
Ordinary Dry Large	20/6 to 21/-
Best Black Vein Large	20/- to 20/6
Western Valley Large	19/- to 20/-
Best Eastern Valley Large	19/- to 19/6
Ordinary ,, ,,	18/9 to 19/-
Best Steam Smalls	12/- to 12/6
Ordinary ,,	10/- to 12/-
Washed Nuts	19/- to 27/6
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	17/- to 18/-
No. 2 ,, Large	17/9 to 18/6
,, ,, Through	16/- to 17/-
,, ,, Smalls	11/- to 12/-
Foundry Coke (export)	37/6 to 40/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	20/- to 23/-
Pitwood (ex ship)	27/6 to 28/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	40/- to 42/6
Seconds	32/6 to 36/-
Red Vein	28/- to 31/-
Machine-made Cobbles	55/- to 57/6
Nuts	55/- to 57/6
Beans	41/6 to 43/-
Peas	20/- to 24/-
Breaker Duff	8/- to 8/6
Rubbly Culm	10/- to 10/9
Steam Coals:	
Large	22/- to 23/6
Seconds	20/- to 22/-
Smalls	9/6 to 10/6
Cargo Through	16/6 to 18/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market, 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Outlook.

THE fear that the new taxation proposals will have the effect of increasing production costs is stimulating a demand which is likely to promote activity in some branches of the engineering industry. Especially is this the case in electrical engineering, in which one big firm has secured sufficient orders during the past two weeks to keep it busy for three months. The requirements in electrical machinery are particularly heavy, and are steadily growing, and buyers are at present favoured by a competition amongst manufacturers brought about by the difficulty of fixing prices in view of the fluctuating values of raw material. As a means of giving a more stable character to business, the electrical engineering firms have now agreed to a scale of prices based upon the values of raw material, and the period of concessions is now apparently at an end. In other branches of the engineering trades the situation is not, on the whole, unsatisfactory, for while some of the big companies are showing unfavourable balance sheets, the smaller concerns have generally been making profits, and if confidence should be restored by an improvement in the financial situation, there will certainly be a development of business during the present year. The condition of the locomotive and wagon-building departments may alone be regarded as distinctly bad.

A Transalpine Railway.

The carrying out of railway and other public works has been seriously retarded by the financial stringency; but nevertheless steady progress continues to be made with several of them, and it is expected, for example, that the Transalpine line between Nice and Cuneo will be opened to traffic in the spring of 1928. This is the only line traversing the Alps at present under construction. All the other projects, including the tunnelling of Mont Blanc, appear to have been abandoned. The railway between Nice and Cuneo is expected to have considerable value by bringing the rich productive regions of the province of Turin into direct communication with the south-eastern departments of France. On the Italian side the line has already been constructed between Cuneo and the Col de Tende, and in France the works are well advanced. Having a length of 76¼ miles the railway has a single track, although it is being constructed with a view to the laying of a double track in the future. On leaving Nice the railway follows the valleys of the Escarène and the Redebraus, and then passes under the Col de Braus by a tunnel 5939 m. long. Then descending the Bevera Valley it passes under Mont Grazian by a tunnel 3888 m. long, and on leaving Breil it follows the Roya Valley to the frontier. From Breil there is a branch line to Vintimiglia, which is thus placed in direct communication with Turin. The steepest gradient is 25 millimetres per metre, and the minimum radius of curve is 300 m. The line necessitates the construction of a number of bridges and viaducts. In the northern part of the Alps the traffic by Mont Cenis is also to be accelerated by the electrification of the line between Modane and Culoz.

Flood Protection.

The carrying out of works for the protection of Paris against floods is only regarded as a necessity when the floods actually occur. The elaborate programme which was prepared more than ten years ago has only been executed to the extent of raising the embankments and removing the barrage at La Monnaie. The other big undertakings were the subject of so much discussion that the original programme has been entirely remodelled and is still liable to undergo changes. All that appears certain is that the Seine will be deepened below Paris, that one of the proposed flood reservoirs in the upper valley of the Seine may be constructed, and that the Alma Bridge will be replaced eventually by another offering a less serious obstacle to the flow of the river. The works already carried out have certainly attenuated the risk of floods, but the present rising of the Seine, which is again reaching the danger level, shows the necessity of putting the works in hand without further delay. The Municipal Council has voted a sum of money for emergency protection, and in view of the seriousness of the situation, it may be supposed that the more comprehensive scheme will be started upon during the present year.

Railway Accident.

The series of railway accidents has been continued by one of a peculiar character, which took place on the Sceaux line in the suburbs of Paris. Two locomotives left the shed at Montrouge in the evening, and after following parallel tracks, were to have been switched on to one track at an interval of ten minutes. By some mistake both locomotives reached the points at the same time and one ran into the other. The latter was thrown across the main line just as a train was approaching. The second collision was particularly violent, and the leading coaches, fortunately with no one in them, were smashed to pieces. In the other part of the train twenty passengers were more or less seriously injured.

The Joy Stick.

The numerous cases that have been before the Courts for years past for an alleged infringement of the "joy stick" system of aeroplane control invented by M. Esnault Pelterie have now been finally settled in favour of the inventor. Soon after the Armistice proceedings were taken against a number of aeroplane builders and also against the Minister of War, who had specified the fitting of the "joy stick" to the machines constructed for the Army. The makers shielded themselves behind the Minister of War, and when the Court of Appeal upheld the validity of the Esnault-Pelterie patents, one of them carried the case to the Cours de Cassation, the judgment of which is final. The Cours de Cassation has just given its verdict in favour of M. Esnault-Pelterie, who is thus assured of the successful issue of the proceedings he has taken against other firms.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

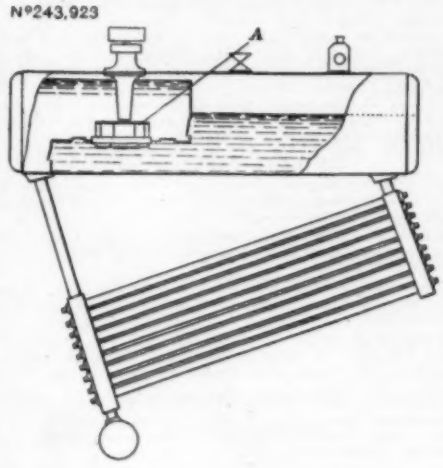
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

243,923. January 22nd, 1925.—FORCED CIRCULATION, R. S. Mansel, 22, Golders-gardens, Golders Green, London.

It would appear from the wording of this specification that the inventor fears that the circulation in a water-tube boiler may not be sufficiently vigorous, when the boiler is being pressed to

N°243,923



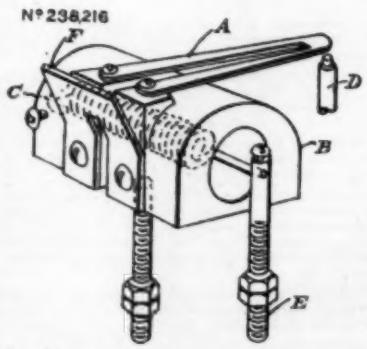
the limit of its capacity, to prevent the tubes from being overheated. For this reason he makes arrangements, such as that shown in the drawing, in the form of a pump A, which forcibly maintain the circulation of the water through the boiler.—*December 10th*, 1925.

SWITCHGEAR.

238,216. July 25th, 1925.—IMPROVEMENTS IN PROTECTIVE RELAYS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, W.C. 2.*

It is often desirable to vary the current-carrying capacity of a temperature relay to enable it to afford protection to an electrical translating device having a similar thermal characteristic, but of greater current rating than that of the device which the relay was initially designed to protect. The temperature relay described in this specification comprises a thermal responsive element A of the bi-metallic type, a heat storage mass B and an electrical heater C. The storage mass B is divided into two parts, which are separated by an insulating partition of asbestos, and the thermal responsive element A is mounted upon shoulders or bosses formed upon each portion of the thermal storage mass B, so as to be in both electrical and heat-conducting relation therewith. The free end of the element A is arranged to move into engagement with the stationary contact D, when the element A is heated to a predetermined temperature. The heating coil C is connected at one end to the relay terminal E, and at the other end to the left-hand portion of the heat storage mass B. In order to increase the current carrying capacity of

N°238,216



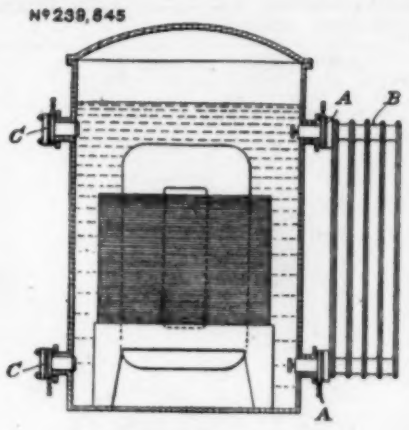
the relay, a shunt F is provided for diverting the increased current from the thermal responsive element A, and is formed of a strip of suitable resistance material, which may be slotted to permit one end t be secured in intimate heat-conducting relation with each portion of the storage mass B, and at the same time furnish a path of suitable ohmic resistance in shunt with the thermal element A. If the capacity of the relay is increased, for example, three times, the resistance of the shunt would be one-half that of the thermal element. With this arrangement, the heating effect of the current through shunt F is transmitted to the heat storage mass B rather than to the thermal responsive element A. This permits the heating coil C to be redesigned with a lower resistance, so that with the increased current the watt loss therein, plus the watt loss in the shunt F, is the same as the watt loss of the heater alone in the original relay. Since the physical proportions of the thermal element A and the heat storage mass B remain unchanged and since the watt loss applied to heating these respective elements with the increased capacity is the same as with the normal capacity, it will be evident that the time load heating characteristics of the relay remain unchanged.—*November 26th*, 1925.

TRANSFORMERS AND CONVERTERS.

239,845. August 29th, 1925.—IMPROVEMENTS RELATING TO TANKS FOR ELECTRICAL TRANSFORMERS AND THE LIKE, The Metropolitan-Vickers Electrical Company, of 4, Central-buildings, Westminster.

It is desirable to have the external radiators of large transformers or similar apparatus detachable in order that they may be removed during transit. The transformer windings are carefully dried and the tank filled with dehydrated oil, when it is tested in the factory prior to shipment, and in order to avoid a repetition of these operations when the transformer is placed

N°239,845

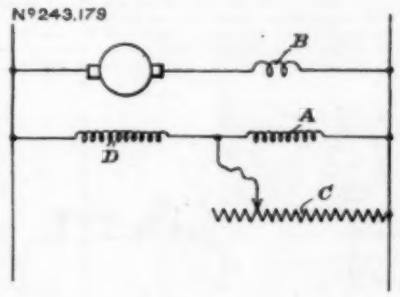


in service, it is essential to ship the tank filled with oil. According to this invention, valves A are interposed between the casing of the transformer and the radiator B. The valves have a disc and seat projecting into the transformer tank, and offer substantially no obstruction to the flow of oil through the radiators. If it is necessary to detach the radiators during transit, the valves are covered by a plate C to prevent loss of oil in the event of the valves being tampered with. The valves are constructed on spiral lines, and full details of the construction are given in the specification.—*November 26th*, 1925.

243,179. December 10th, 1924.—IMPROVEMENTS IN OR RELATING TO DYNAMO ELECTRIC MACHINERY, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C. 2, and Frank Percy Whitaker, of 237, Clifton-road, Rugby.

This invention relates to rotary converters or motor converters that are not provided with boosters and has for its object to provide a convenient method of automatically increasing the

N°243,179



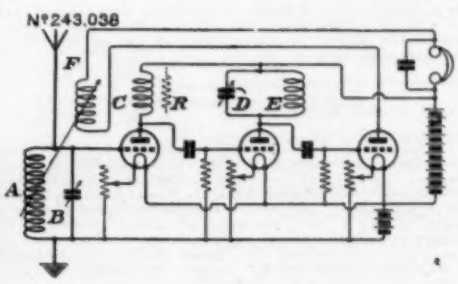
excitation of the commutating poles for a given load. In the case of the arrangement shown the auxiliary winding A is arranged, with respect to the series winding B, so as to oppose the latter, whereby, when the rheostat C is adjusted to increase the field current in the main winding D, the current taken by the auxiliary winding A is reduced, and the effective energisation of the commutating pole windings is also increased. Two other schemes are illustrated and described.—*November 26th*, 1925.

TELEGRAPHS AND TELEPHONES.

243,038. May 24th, 1924.—IMPROVEMENTS IN AND RELATING TO AMPLIFYING APPARATUS, PARTICULARLY FOR WIRELESS RECEPTION, John Scott Taggart, of Devereux Buildings, Devereux-court, Strand, W.C. 2.

With the object of avoiding self-oscillation when using a number of high-frequency valves, the inventor avoids the effects of a number of tuned anode circuits, by arranging matters so that tuned circuits have untuned or intentionally damped anode circuits between them. Five alternative schemes are

N°243,038



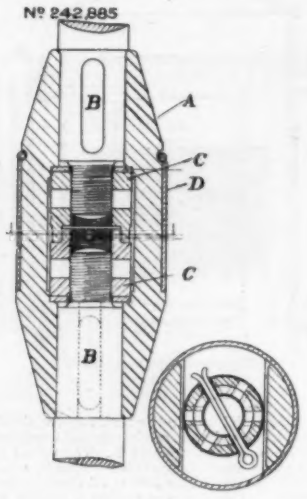
described, and the diagram shows one of them. It will be seen that the aerial circuit A B is tuned, and is included in the grid circuit of the first valve. The anode circuit of this first valve contains a choke coil C, the connection to the grid of the second valve being through the usual grid condenser. The anode circuit of the second valve, however, contains an ordinary tuned anode circuit D E, the anode of this second valve being connected to the grid of the third valve, which acts as a detector. In the anode circuit of this third valve is a reaction coil F. At the right-hand side of C a resistance R is shown in dotted lines,

this indicating that this resistance can be used instead of the choke C. The usual value of such a resistance would be of the order of 100,000 ohms, and will usually be most suitable for wave lengths over 1000 m.—*November 24th*, 1925.

TRANSMISSION OF POWER.

242,885. May 7th, 1925.—SHAFT COUPLINGS, The Mirrlees-Watson Company and W. A. Dexter, 45, Scotland-street, Glasgow; and J. E. Sargeant, 98, Minard-road, Crossmyloof, Glasgow.

This coupling is intended for purposes such as that of joining together the sections of shaft for a deep well, in which both tension and torque have to be transmitted from one piece to

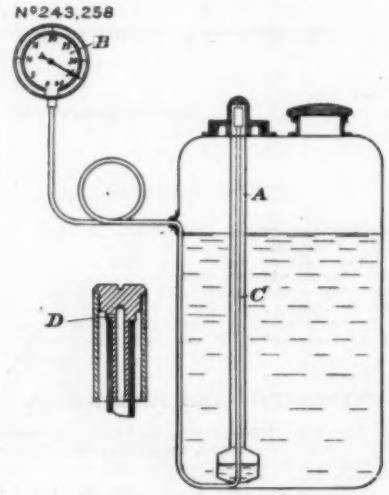


another. The adjacent ends of the shafts are embraced by a muff A which serves to transmit the torque from one to another by means of the keys B B. The tension in the shaft, brought about by its weight, is met by the nuts C C screwed on to the ends of the shafts. The openings for getting these nuts into position are shown in the end section and these openings are closed by a light shield D.—*November 19th*, 1925.

MEASURING AND TESTING INSTRUMENTS.

243,258. June 8th, 1925.—LIQUID LEVEL INDICATORS, G. Dubreuil and L. Dubreuil, 3, rue Orfila, Paris.

This gauge is intended for petrol tanks and similar purposes, and is of the manometric type. The invention is concerned with the disturbance of the readings of the gauge through the condensation of petrol in the pipe connections. The instrument works on the usual principle of measuring the air pressure in a



vessel A open at the bottom and closed above. The air pressure, and consequently the depth of liquid, is indicated on the dial B. In order to prevent petrol splashing up into the connecting tube C, it is provided with a cap, as shown in the detail drawing, and the opening is a hole D of smaller diameter. It is claimed that the fineness of this hole also prevents the ingress of petrol vapour, but allows the transmission of the air pressure.—*November 26th*, 1925.

LANTERN SLIDES.—Marshall, Sons and Co., Ltd., of Gainsborough, ask us to announce that they have available for lecture purposes a large number of slides illustrating various types of steam engines, road-making machinery, haulage engines, boilers, and other classes of "Marshall" power plant, and that they have recently added a new series which comprises "Marshall" oil engines for various power services, water pumping, sewage pumping, electric lighting, &c. Messrs. Marshall will be happy to lend these slides for the purposes of lectures to anyone desiring such means of illustration.

A.M.I.E.E. EXAMINATION.—The next examination for associate membership of the Institution of Electrical Engineers will be held on April 15th, 16th, and 17th, 1926. Candidates must be either students or graduates of the Institution or have lodged with the secretary a duly completed form "E" for election as associate member. Entry forms for the examination, which must be completed and returned by February 1st, and particulars regarding election to membership of the Institution may be had on application to the Secretary, the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHEMICAL ENGINEERING GROUP.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Papers, "The Manufacture of Hydrogen Suitable for the Hydrogenation of Oils," by Mr. A. E. Knowles; "The Production of Hydrogen by Micro-organisms," by Dr. A. C. Thaysen. 8 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Paper, "Dock Engineering," by Mr. S. J. Davies. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Third Report of the Marine Oil Engine Trials Committee. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Notes on Salesmanship," by Mr. A. J. Simpson. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne. "Star Contra Propeller," by Mr. Walter Pollock. 7.30 p.m.

SOCIETY OF TECHNICAL ENGINEERS.—Queen's Hotel, Birmingham. Paper, "The Research Factor in Cable Making," by Captain P. Dunsheath. 7.30 p.m.

SATURDAY, JANUARY 9TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Manchester. Paper, "Liquid Shrinkage in Grey Iron," by Mr. J. Longden. 4 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the Peckham Rye Repair Shops, Southern Railway, Brighton Electric Services.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Huddersfield. Yorkshire District quarterly meeting. 2 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Children's Lecture, "Old Trades and New Knowledge—the Trade of the Miner," by Sir W. Bragg. 3 p.m

MONDAY, JANUARY 11TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Great Horton-road, Bradford. Lecture, "Mechanical Boiler Flue Cleaning," by Mr. R. Gallaher. 7.30 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Paper, "The Mechanical Properties of Non-ferrous Metals and Alloys at High Temperatures," by Professor F. C. Thompson. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. London Graduates' cinema evening. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, New-street, Birmingham. Paper, "The Elimination of Noise in the Motor Cycle," by Mr. H. Briggs. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—University College, Gower-street, London, W.C. 1. Informal meeting. Discussion on "The Electrical Installation at the Rockefeller Building, University College," opened by Mr. W. C. Clinton. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND, STUDENTS' SECTION.—Temperance Hall, Temple-street, Birmingham. Exhibition of films. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, London, S.W. 1. "The Reduction of Factory Costs," by Mr. E. H. Lewis. 7 p.m.

SURVEYORS' INSTITUTION.—12, Great George-street, London, S.W. 1. Paper, "Recent Forestry Development," by Mr. W. L. Taylor. 8 p.m.

TUESDAY, JANUARY 12TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. Paper, "Electricity Supply Tariffs," by Mr. H. M. Sayers. 7 p.m.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. "Lubrication," by Mr. S. E. Bowrey. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Paper, "Logic Applied to Failures," by Mr. J. D. Parkes. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Paper, "High-level Bridge, Newcastle-upon-Tyne: Underpinning and Repair of Foundations of River Piers," by Mr. C. F. Bengough. 6 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "Failure of Metals by Creep," by Professor W. Kerr. 7.30 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Vapour Pressures of Fuel Mixtures," Part II., by Mr. J. S. Lewis, followed by a discussion on "The Estimate of Unsaturated and Aromatic Hydrocarbons," opened by Professor J. S. S. Brame. 5.30 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Queen's Chambers, 5, John Dalton-street, Manchester. Presidential address, by Mr. R. Landless. 4 p.m.

POPLAR SCHOOL OF ENGINEERING OLD BOYS' SOCIETY.—High-street, Poplar, London, E. 14. Paper, "The Tower Bridge, its History, Construction and Erection," by Mr. N. S. Williams. 7.45 p.m.

ROYAL AERONAUTICAL SOCIETY.—Aeronautical Section of the Science Museum, South Kensington, London, S.W. 7. Conversazione. 8.30 p.m.

WEDNESDAY, JANUARY 13TH.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN: BIRMINGHAM AREA TECHNICAL COMMITTEE.—Chamber of Commerce, New-street, Birminghain. Lecturette, "Springs," by Mr. J. Mitton. 7.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS.—Chemical Society's Hall, Burlington House, Piccadilly, London, W. 1. Papers: "A Critical Review of Published Experiments in Filtration," by Mr. A. J. V. Underwood; "Tube Mill Grinding—with Special Reference to Grinding in a Current of Air," by Dr. G. Martin. 8 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Informal meeting. Discussion on "The Testing and Examination of Materials for Railway Construction," introduced by Mr. F. J. Paice. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Grand Hotel, Birmingham. Annual dinner.

INSTITUTION OF ENGINEERS-IN-CHARGE.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Paper, "Industrial Economics," by Mr. J. W. L. Rowe. 8 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Swindon. Southern District meeting. 11 a.m.

THURSDAY, JANUARY 14TH.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Hotel Metropole, Leeds. Paper, "Recent Developments in Centrifugal Pumps for Waterworks, Sewage and other Purposes," by Mr. F. Kennerley Preston. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—9, The Temple, Dale-street, Liverpool. Third Report of the Marine Engine Trials Committee, presented by Mr. Sterry B. Freeman. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the Tobacco Factory of Carreras, Ltd., City-road, London, E.C. 1. 1.45 p.m.

FRIDAY, JANUARY 15TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Non-ferrous Section, Applied Science Department, the University, Sheffield. Paper, "The Early History of Gold," by Professor C. H. Desch. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. Paper, "The Wire-drawing Process," by Professor F. C. Thompson. 7.15 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Characteristics of Electric Lamps in Relation to their Testing," by Messrs. B. P. Dudding and G. T. Winch. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Novelties at the 1925 Engineering Exhibitions." 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Middlesex County Hall, Westminster, London, S.W. 1. Metropolitan District meeting. 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "The Commercial Side of Foundry Work," by Mr. J. Wolstenholme. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, Albert-square, Manchester. Paper, "The Value of Research in the Production of Castings," by Mr. J. G. Pearce. 7.15 p.m.

RAILWAY CLUB.—65, Belgrave-road, London, S.W. 1. Paper "Railway Signalling from a Traffic Point of View," by Mr. "Wagenrieder. 7.30 p.m.

SATURDAY, JANUARY 16TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Greenwood's Café, Todmorden-road, Burnley. Annual social. 5 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—College of Technology, Manchester. Lecture, "Some Factors that Constitute Problems in the Foundry," by Mr. S. G. Smith. 7 p.m.

MONDAY, JANUARY 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Loughborough Graduates' meeting. Paper, "Sparking Plugs," by Mr. C. Legge. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "Logic Applied to Failures," by Mr. J. D. Parkes. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-WESTERN SECTION.—Manchester Geographical Society's Hall, 16, St. Mary's Parsonage, Manchester. Lecture, "The Importance of the Selling Aspect of Production Planning," by Mr. W. D. Adamson. 7.15 p.m.

TUESDAY, JANUARY 19TH.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. "Poetry and the Engineer," by Mr. W. Blanc. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "The Straight Eight Engine," by Mr. E. W. Sisman. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Engineering and Scientific Club, Queen-street, Wolverhampton. Paper, "The Elimination of Noise in the Motor Cycle," by Mr. H. Briggs. 7.30 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. Paper, "The Principles which Govern the Heat Treatment of Non-ferrous Alloys," by Professor F. C. Thompson. 7.30 p.m.

WEDNESDAY, JANUARY 20TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Birmingham Graduates' meeting. Paper, "The Straight Eight Engine," by Mr. E. W. Sisman. 7.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, London, S.W. 1. Paper, "Concrete Roads in America, and the Application of their Principles of Design and Construction to Great Britain," by Major R. A. B. Smith. 8 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—The Engineers' Club, Coventry-street, London, S.W. 1. Smoking concert. 7.30 p.m.

THURSDAY, JANUARY 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Training School of Vauxhall Motors, Ltd., Luton. Luton Graduates' meeting. Paper, "Epicyclic Gearing," by Mr. C. E. Gritton. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. London Graduates' meeting. Paper, "The Design of Light Alloy Pistons," by Mr. L. F. Little. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—The Engineers' Club, Manchester. Annual meeting. Paper, "Piston Temperatures and Heat Flow in High-speed Petrol Engines," by Professor A. H. Gibson. 7 p.m.

ROYAL AERONAUTICAL SOCIETY.—7, Albemarle-street, London, W. 1. Lecture, "The Schneider Cup Race, 1925," by Major J. S. Buchanan. 6.30 p.m.

FRIDAY, JANUARY 22ND.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Piston Temperatures and Heat Flow in High-speed Petrol Engines," by Professor A. H. Gibson. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "The Engineer and his Relationship to the Tea Industry," by Mr. E. Granville-Smith. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne. Paper, "Cast Iron for Diesel Engines," by Mr. A. Campion. 7.30 p.m.